ON THE VOLCANO OF TAAL.

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(Plates xviii and xix.)

During my travels in the Philippine Islands I paid a visit to the active volcano of Taal, which, on account of its peculiarities, its situation and its long-continued activity, is certainly one of the most remarkable volcanoes of the world. It is situated amongst the Philippines, in the Island of Luzon, at no great distance from Manila, between N. lat. 13° 52′, and 14° 7′, and long. about 121° E. It is in the north-west portion of the province of Batangas, and almost due south of Manila. The bay of Manila which makes a deep indentation on the south end of Luzon, is succeeded after a short interval of coast line by the Seno de Balayan, a small bay, and separated from this by a narrow ridge of ash and coral sand, is a lake in the centre of which is the active crater of Bombon or Taal.

I propose in the following paper to give a statistical, geological and botanical account of this volcanic district, together with such particulars of its history as I have been able to collect from Spanish sources.

Literature.—The historical records of the Philippine Islands are very abundant. Most of the Missionary Orders have published annals of their religious enterprises, and have kept occasional chronicles of anything remarkable which occurred in their respective missions. All these have been printed under their own auspices, and now form a voluminous library, in which it is easy to trace any event of importance since the Spaniards came into possession of the Philippine Islands. I believe there are no colonial possessions in the world in which the literature connected with the country is so extensive.

The following are the principal works to which I have had recourse in preparing this essay, and I take this opportunity of expressing my thanks to the following gentlemen who have given me untiring assistance in studying the history and literature of the subject:—Padre Faura S.J., Padre Lozano, and Padre Blanco, of the Augustinian Monks at Manila and Iloilo.

"Buzeta, Diccionario Geografico Estadistico Historico de las Islas Filipinas." Madrid 1851.

"Estudio Gèológico del Volcan de Taal por José Centeno, Inspector general de Minas de Filipinas." Madrid 1885.

"Relación de lo sucedido en el volcán de la Laguna de Bombong, escrita en Bauán en 22 de Diciembre de 1754" Por P. Fr. Francisco Bencuchillo."

"Boletin de le Carta Geologica del España." In this work is quoted (Vol. VIII.), the work of a German, Richd. von Draasch, published at Vienna, which work I have not been able to consult. It is entitled, "Data for a Geological Study of the Island of Luzon."

"Reise der österreichischen Fregatte Novara um die Erde."

"Tierras y Razas del Archipiélago Filipino por Jose de Lacalle y Sanchez." Manila 1886.

"Phanerogamæ Cumingianæ Philippinarum." Manila 1885.

"Viajes por Filipinas de F. Jagor, Traducidos del Aleman por S. Vidal y Soler." Madrid 1875.

"El Mayon, ó Volcán de Albay (Filipinas)" por Don Enrique Abella y Casariego. Madrid 1885.

"El Monte Maquilin (Filipinas) e sus actuales emaciones volcanicas" por Don Enrique Abella y Casariego. Madrid 1885.

"Memoria sobre los Temblores de Tierra occuridos en Julio de 1880 en la Isla de Luzón" por Don José Centeno y Garcia. Madrid.

"Emanaciones Volcánicas subordinadas al Malinao (Filipinas)" por Don Enrique Abella y Casariego. Madrid 1885.

"Terremotos de Nueva Viscaya (Filipinas) en 1881, por Don Enrique Abella y Casariego." Madrid 1884.

"Murillo Velardo (P. Pedro) Historia de la provincia de Philipinas de la compañia de Jesus, que comprehende las progressos de esta provincia desde 1616, hasta 1716."

"Zuñiga (Martinez de) Historia de las islas de Philipinas compuesta por el R. P. lector Fr. Joaquin Martinez de Zuñiga En Sampaloc por Fr. Pedro Argüeles, 1803 in 4 de 4 ff. prélim. et 687 pp."

"Zuñiga (Martinez de). An Historical View of the Philippine Islands: from the Spanish (published at Manila 1803), 2 vols. 8vo., Lond. 1814."

"Novissima Appendix ad Floram Philippinarum. R. P. Emmanuelis Blanco, Auct. P.P. F.F., Naves et Villar. Augustinianis." Manila 1880.

"Sinopsis de familias y generos de plantas leñosas de Filipinas, Introduccion á la flora forestal del Archipielago Filipino, redactada por Don Sebastian Vidal y Soler." Manila 1883.

"Reisen im Archipel der Philippinen von Dr. C. Semper." Wiesbaden 1877.

"Guia Oficial de Filipinas 1885." Manila 1884-5-6.

"A Descriptive Dictionary of the Indian Islands and adjacent countries." By John Crawfurd, F.R.S., London, 1856.

"Plantkundig, Woordenboek voor Nederlandsch-Indië." G. J. Filet, Leiden, 1876.

"Planten van Nederlandsch-Indië, Bruikbar voor Handel, Nijverheid en Geneeskunde, door A. H. Bisschop Grevelink." Amsterdam 1883.

"Une Mission aux Iles Philippines et en Malaisie par M. le Docteur J. Montano." Paris 1885.

"Die Philippinen und ihre Bewohner, Dr. Semper, Würzburg, 1869."

"Revista de Filipinas" 1875 to 1877. Manila.

From the above works the one which I have had occasion to make most use of, is the Estudio Geológico of José Centeno, Inspector-General of the Mines of the Philippines, published by Royal Order at Madrid in 1885. Señor Centeno was commissioned

to make a geological examination of the central volcanic region of Luzon, which includes a great part of the provinces of La Laguna, Batangas and Tayabas. This is one of the most interesting regions in the islands, since it includes the volcanoes of Majajay, Banajao (over 8,000 ft. above sea level), San Cristobal, Calauang, Maquilin and Taal. All these mountains are, in some sense, either in activity, or, it may be said, smouldering, and give evidence of the fires at no great distance underneath the soil by boiling springs, solfataras and frequent shocks of earthquake. Besides the mountains above enumerated there are other volcanic cones of less importance. Señor Centeno has already published his labours on Maquilin as well as on the Volcano of Taal, and they form together singularly complete accounts of the whole geological history of these interesting localities. In fact they have left very little for any observer to do, but I am not aware that they have ever been laid before the public in the English language. I should mention further, that I had an opportunity of comparing all my own collections with those made by different observers at the Commission of the Forest Flora, where an excellent herbarium has been gathered together by Señor Vidal y Soler. The minerals I compared at the museum of the Jesuit Fathers at the Athenée Municipale. I take this opportunity of acknowledging the extreme courtesy of Señor Vidal y Soler, and Padre Suarez, S.J., the Curator of the Museum.

Situation.—The Volcano of Taal is, as already stated, situated in the midst of the Lake of Bombon, whose only outlet to the sea in the Straits of Mindoro is the River Pansipit, a small stream scarcely six miles in length, which first flows south-west and then south, disemboguing a little below the town of Taal, which derives its name from the crater. This town is just visible, or rather the church and a few important buildings are visible from the anchorage. On the north side of the river is the suburb known as Lemeri, and about five miles to the south is the town of San Luis, so that the place has a populous appearance. Taal is, like many of the important centres of population in the country places which boast of a parish priest and a gobernadorcillo, a

well-to-do centre of an agricultural district. It has a population of between forty and fifty thousand, and consists of the usual crowded streets of bamboo huts shaped like bee-hives, with a fine stone church in the midst, a ruined Casa Reale, and one or two other stone buildings of modest pretensions. It is a favourite watering-place, whose situation, the neatness of its streets, its fine Plaza, and the multitude of its houses give it a very picturesque appearance. This is much increased by the surrounding meadows, orchards, and gardens, all of tropical beauty and luxuriance. The climate, from its proximity to the sea, is said to be fresh and agreeable and free from the epidemic maladies of the islands. Nevertheless, the Spaniards resort to it but little. There are scarcely any European residents, the large population consisting almost exclusively of Tagalo Indians with a few Mestizos. When the Spaniards originally settled on this part of the coast they found a large native population established further from the sea and nearer to the lake, and here the missionaries built their church, and the officials their civil and military establishments. But all this and the town itself were destroyed by the terrible eruption of the volcano in the month of December 1754. When this ceased and the population began to return to their fields, the town was founded anew on the banks of the river, and as far as possible from the volcano. The ruins of the former town form conspicuous objects in the plain.

The parochial church is of the usual Spanish style, evidently constructed with a view to probable earthquake contingences. There is a Campo Santo or public cemetery of the kind usual in the Philippines, that is a combination of cemetery and catacomb. It is, however, far from the population and well-ventilated. There is a primary school, a monastery and a prison. The soil in the neighbourhood, like most volcanic regions, is very rich. Its principal productions are wheat, rice, maize, coffee, cocoa, pimento, —which includes pepper, capsicums, chilis, and other hot condiments —hemp, cotton, besides many vegetables and abundance of fruits. Moreover, as the country abounds with aromatic flowers, there are bees in abundance, from which the natives gather valuable stores

of honey and wax. In the wide and rich pastures of Taal there are large herds of live stock, including cattle, horses, goats and sheep. They also support many wild animals, including deer, monkeys, wild boars, foxes, porcupines, ferrets, hedgehogs ; wild fowl, including ducks and geese, pheasants, pigeons, and snipe are abundant. In the town the principal industry is the production of cotton from the pods of the algodonero *(Gossypium)*. The quality of the cotton produced is considered to be superior to that of almost any other portion of the Philippines. Great quantities are prepared by the population, and woven into a multitude of fabrics such as broadcloths and stuffs for wearing apparel, both coarse and fine, in which branch of industry large numbers of persons of both sexes are employed. They also dye the produce of their looms, and the colours they are able to give are brilliant and varied, besides being permanent. There is also a considerable amount of oil produced from the *Sesamum*, Til or Teel plant, mainly used in this country for illuminating purposes, and for preparing pigments. The seeds of the plant (*Sesamum indicum*), produce the oil which is tasteless as olive oil, and used as an adulterating oil as well as for food. It would form a valuable export but for its tendency to become rancid. A good proportion of the population are fishermen, partly in the sea and partly in the lake. The fishes which are caught in the latter, though the waters are nearly fresh and in the driest seasons only slightly brackish, are all marine. They are said to be of an excellent flavour, and prized more highly than any in the Philippines. The species most esteemed is what the Spaniards call salmon, but which I belive to be mullet (*Mugil*), which comes up the river Pansipit in great shoals at the spawning season. The Tagalo natives form a stockade of thick bamboos across the stream when the fish are migrating to and from the lake. Above the stockade there is a broad bamboo platform with raised margins on which numbers of natives, male and female, await the return of the shoals. As soon as the fish perceive the stockade they leap high into the air, and are caught on the platform, where they are quickly despatched by short sticks. They are of good size, weighing on an average

from five to seven pounds. The exports from Taal are to Manila only, and include large quantities of beeswax, honey, onions, garlic, wheat, large herds of cattle, and a great quantity of cotton stuffs. The latter fabrics being made by hand-spinning and hand-looms, are much stronger and more durable than our calicos. The thread is dyed before weaving, and thus the patterns are all plaids.

The Lake of Taal, Bombon or Bombong, in which is the volcanic island, is situated between N. lat. 13° 52′ 4″ and 14° 7′ 42″, and E. long. 120° 47′ 17″ and 120° 59′ 22″. Its figure is somewhat rudely heart-shaped, with a prolongation to the southward into a narrow bay. Almost in the centre is the volcanic island which is lozenge-shaped, the angles of the major axis being directed north-east and south-west. The circumference of the lake is about 75 miles, its greater diameter from north to south nearly 20 miles, and its least width from east to west nearly 13. The dimensions of the island will be given presently. It is sufficient now to say that it occupies a very large proportion of the lake area. The Cordillera which divides the province of Batangas and the province of Cavite, and the elevation of all the surrounding country give to the lake and its neighbourhood the appearance of a cauldron when seen from any eminence, a comparison first made by one of the early historians of the Philippines, Fray Martinez Zuñiga, whose intelligent geological opinions will be noticed presently. On the northern shores are the ruins of Tanauan, and on the south-west, as already stated, those of Taal on the banks of the river Pansipit, and to the north-west the ruins of the district of San Nicolas, and on the eastern banks the bed of the river Sala, near to which was formerly situated the town of that name. All these places were completely destroyed by the disastrous eruption of December 1754.

From the margins of the lake there is a gentle rise in certain portions with slight undulations forming fertile declivities of agricultural land, as for instance at Bañadero, Aya, Talisay, Bayuyungan, and in general on all the northern and western sides. In other portions the margins rise abruptly forming gorges and ravines mostly on the eastern side limited by Mount Macolod and

its dependent ridges. These extend parallel to the margin of the lake, like a wall bounding the rich and populous agricultural districts surrounding the large towns of Lipa, Cuenca and San José. All these towns are on a kind of plateau about 1000 ft. above the level of the sea. This plateau may be called the culminating portion of the land which surrounds the mountains Macolod and Sungay, and it slopes down gradually westward towards the river Pansipit. This as already stated is the only outlet of the lake, and by its very slight fall shows the very small difference there is between the level of the lake and the sea.

Of the two above-mentioned mountains, Macolod and Sungay, which with their dependent ridges, as it were, surround the lake, Sungay is on the north, and Macolod on the south. The highest point of Sungay is the Pico Gonzalez, which is about 2,200 ft. above the level of the sea. There is an extension of the mountain ridge to another peak called Ilong-Castila, distant about ten kilometers, and slightly less elevated than Pico Gonzalez. The elevation is continued by the Cordillera of Tagatay, which slopes down towards Mount Batulao on the south-west, whence extend ridges with a generally southerly trend, and filling up the land between the sea, the lake, and the river Pansipit.

Mount Macolod is about 3,243 ft. above the level of the sea. It forms a very conspicuous bluff, as already stated, on the south-east side of the lake. This mountain is quite precipitous on the lake side, and declines very rapidly towards the sea, sending a long peninsula out into the ocean, which forms the boundary between the two bays of Balayan and Batangas. On the north-east at some considerable distance is the extinct volcano of Maquilin, from the base of which spring forth the very hot springs of Los Baños. There is no river of any importance emptying into the lake, but in the rainy seasons there is considerable drainage from the slopes all round, which is supposed to be sufficient to counterbalance the evaporation. The weathering effect of the rains upon the loose volcanic soil must, I should say, be very great, especially during the summer monsoon when the downpour is so heavy and continuous. I noticed several large and rugged ravines, and I

was informed by the natives that the shore-line is very rapidly changing its contour. Many capes and points disappear during the rainy season, especially on the volcanic island which is composed of loose ash. In the Geological Essay of Draasch already referred to, the author puts forth well-grounded reasons for supposing the existence of thermal springs and subterranean affluents. Considering the great height of the mountains and ridges all round the lake, and the abrupt way in which some of them abut upon it, no doubt there must be a very extensive soakage into the bottom of the basin. At the time of my visit, which was at the close of an unusually dry season during which there had not been a drop of rain for nearly three months, there was a not inconsiderable stream of water flowing into the lake at the place where I embarked. This was on the low flat ground on the north-east side, at the nearest point to Mount Maquilin.

The depth of the Lake of Bombon is considerable considering its small extent. The deepest soundings are found on the south-east side where Mount Macolod abuts in precipitous cliffs upon the water. Here a depth of 106 fathoms has been obtained at a short distance from the shore. The soundings to the west and north are between 30 and 80 fathoms, and generally the lake is deeper towards the west than to the north. I noticed as we landed upon the island crater that there were several marine remains on the shore, such as dead coral and fragments of sea shells similar to what is generally seen on coral reefs in the open ocean.

Besides the island crater there are two or three little islands in the lake on the north-east of the strait, which separates the volcano from the Cape of De Lipa. The largest of these is Napayong, which is nearly a mile long and a third of its length wide. One side of this island ends in abrupt precipices of tufa, 350 ft. above the surface of the water. There are three other little islands and some rocks. These islands are generally precipitous, yet when the volcano is sufficiently tranquil they are inhabited, and in part cultivated. Cotton, Manila hemp, and bananas are grown, and a few live stock kept. The appearance of these islands is very picturesque, the whole of the precipitous

faces are richly festooned with the usual luxuriant foliage of wild vines and tropical plants.

Before coming to a description of the details of this singular volcano it will perhaps be better if I describe briefly the mode and times of my visits. I first saw it towards the end of March, 1885, when, after a long period of tranquillity, the volcano had subsided into a state of repose as great, almost, as ever has been known. I travelled from Manila up the river Pasig into the laguna of Bay by means of a small trading steamer. I landed at the south side of the laguna at the large and populous town of Calamba at the mouth of the river San Juan. From Calamba I followed this river which winds round the base of Mount Maquilin, and passing the town of San Tomas proceeded to Tanauan. This town is almost as important as Calamba, with a fine market place and Casa Reale all in ruins from the earthquake of 1882, or the hurricane of the year after. From Tanauan having crossed the river I descended to the margin of the lake, a distance of about seven miles. I may mention that from the town of Tanauan the peak of the volcano is visible, and was then specially conspicuous by the dense volumes of white smoke which rolled up from the crater high into the air, where, as the day was still and the weather fine, it formed a spreading canopy not unlike a mushroom in shape.

My journey was a most interesting one thus far, but I intend to give a description of it when publishing the full journal of my travels. It will be sufficient to say now that I embarked in a native canoe at the small village of Barnadero, and in an hour or so crossed over to the volcano. This appeared from a distance to be a low, undulating cone of grey ash, with very little vegetation upon it. I landed inside a cape called Caluit, or Calavita, and following a narrow path reached the summit of the crater by a very easy incline. The view from the edge is very startling and extraordinary. One stands on the edge of a crater of oval form, about 2,500 yards in its major, and 2,000 yards in its minor diameter, and about 1,000 feet deep. The first impression is that of a recently extinguished cauldron, from the midst of which two pits, a little separated from each other, were emitting rolling

volumes of thick white smoke. The general colour of the whole was red and fiery with bluish spots and stains on the sides, as if gunpowder had been recently exploded there. But what gave a singular and startling appearance to the scene was three lakes in the bottom of the crater, one in the centre, and the other two at the sides. The centre lake was a greenish-blue like the ocean, and surrounded by a broken crater of reddish-purple scoriæ. There was a confused group of half a dozen broken craters and one great slope encircling half of them. On the north side there was a bright emerald green patch like a pond covered with duck-weed, except that its tint was more vivid than the greenest of green waters. This was succeeded to the north-west by another lake or rather a marshy flat of lemon yellow colour, which deepened on its edges into a golden colour, with great orange stains in places. The eastern and highest side of the crater wall was yellow with sulphur, and all this side was emitting thin jets of sulphurous fumes from cracks and crevices. Indeed most of the walls of the inside were emitting the same fumes. Close below where I stood there was a little jet of sulphur smoke, and on digging down with the iron point of an alpenstock, the ground around was found to be intensely hot.

The slope of the crater on the east side was a very moderate inclination, rendering a descent into it comparatively easy. Accompanied with two natives as guides, I descended easily to the bottom of the basin. The ground was firm and composed of a mass of broken cinders, but there was evidence that at no great depth these deposits were scarcely cool, as from the cracks and crevices sulphurous fumes were emitted. The yellow tint of sublimed sulphur was on everything.

I made my way first of all to the bluish-green lake in the centre. The rocks were exceedingly rough and scoriaceous, forming walls round one portion of the waters which afforded no foothold, but were quite precipitous. I found it very difficult to obtain samples of the water, but by means of a bamboo with which we were provided, and a sodawater bottle, this was accomplished. I next turned my attention to the green lake, and found the same kind

of difficulty in getting near the edge, which could only be done from the outer wall. The yellow lake was, at the time of my visit, about 120 yards in length, being a mass of sulphurous paste or crystals of sulphur with oxide of iron, the latter causing orange and reddish stains of considerable extent. Some of these crystals were of large size. In endeavouring to approach the edge of this lake, my Indian guides showed considerable uneasiness lest I should put my foot into some of the soft sulphurous mud which was in places quite scalding hot apparently. In some places one could distinctly see a bubbling up of steam, with patches of agitated water as if it were simmering. Any examination of this locality, I should say, would be fraught with considerable danger. It was my intention to examine the two smoking pits, but my guides displayed so much alarm at the proposition that I concluded there must be more danger in approaching them than I could perceive from a distance. The surface for a considerable distance around them was quite moist, and may have been boggy.

The heat was intense during the time of my visit, though it was scarcely 9 a.m. when I left the crater. My guides kept continually pointing to the sun, and showing me by signs that, when the wind or sea-breeze began to blow, we should be in danger from the sulphurous vapours of the two fumeroles. Under these circumstances I was obliged to shorten my stay. The rest of the time spent upon the island was occupied in going over the ground so ably described by Señor José Centeno. I had the advantage of his maps and his work with me at the time, and I visited every point in succession that is described by him in connection with the volcano. Some little time was taken up also in barometrical observations, as well as in making collections of plants and minerals. The results of these observations will be given as we proceed.

My second visit to the volcano, or rather to the Lake of Bombon, was in March of the year following, but on this occasion I went down to the coast first, and then proceeded to the lake from the town of Taal by way of the river Pansipit. I was not able to land upon the island. During the previous September (1885) there had been a severe eruption, and though not accompanied

with such loss of life as in that historical disturbance in 1754, there was considerable destruction of property. The whole of the verdant slopes around the lake were lying desolate and blackened. A dark covering of cinders covered the ground as far as the eye could reach. There was not a trace of vegetation on the island where I had made extensive botanical collections. Formerly there were many herds of cattle, which, I was informed, were completely destroyed by the eruption before they could be removed. It had no doubt fared badly with the town of Talisay and four or five villages on the north side of the lake. During the height of the eruption the inhabitants had sought safety in flight, leaving their herds and their crops which were nearly all destroyed. From the little fishing village of Bagumi Bayan, a distant view of the island volcano was obtainable. It was emitting very considerable quantities of white smoke with noises and explosions. Though the eruption had very much subsided, yet the emission of ashes and stones was quite perceptible. Even at this time any attempt to approach the volcano would be unsafe.

From what I could perceive at a distance, the form and appearance of many of the ash cones had been quite changed, and some of them obliterated. I was informed that the interior of the crater had been seen by some daring investigator, and that the green and yellow lakes were nearly obliterated for the time being, and the features of the crater quite changed. The time at my disposal during this second visit was occupied with the mollusca of the rivers, and the marine zoology generally, the results of which are appended.

I now proceed to describe the geologic features of the island, which will serve to give a better idea of the prehistoric activity of this volcano.

The island crater is an irregular square but prolonged at three of the angles into diagonal promontories. The north-west and south-western ones are clearly extinct craters. That on the north-east, or as it is termed Pirac Piraso, at its highest point (Mount Bignay) is about 220 ft. above the level of the lake. The north-western prolongation is named Binintiang Malaki. It is a

conical extinct crater about 850 ft. above the level of the lake at its highest part. Inside the truncated cone there is a well-formed crater about 500 ft. deep. There are no further observations to be made on the structure of this hill, except that it is very steep because it is densely clothed with vegetation. The abrupt sides though deeply scarred by ravines dip into the lake at a steep incline. It is here that I made the best portion of my botanical collection. The tangled thicket was principally composed of fig-trees belonging to three or four species, *Tabernæmontana sphærocarpa*, *Mussaenda frondosa*, *Acacia farnesiana*, *Canavalia*, *Vitis*, *Leea*, *Hibiscus*, *Abutilon*, *Mucuna*, *Oroxylum*, &c., with a host of escapes from cultivation to be described hereafter.

The point to the south-west is named Binintiang Munti, a much smaller crater with less vegetation. The basin inside the cone is imperfectly defined, and only about 250 ft. above the level of the lake. From the edge of this crater there is a ridge pursuing a north-east direction towards the volcano. This ridge terminates at a dome-shaped hill called Mount Tabaro, which is about 500 ft. high. This mountain has a special interest, for the sides are scored with deep furrows giving it an appearance as if it had been grooved all round. It exactly resembled a dome in the Sand-See in the island of Java, and like it is placed close beside an active volcano, that of the well-known crater of Bromo. Señor Centeno does not regard this as a crater, but rather an accumulation of ashes around an original nucleus. There is no trace of a basin on the summit. The distance between Binintiang Malaki and Binintiang Munti is something over four miles, and from the first-named point to Pirac Piraso a little over three.

In proceeding to summarize the results of my observations it must be distinctly understood that I do not lay any claim to originality in this matter. The observations of Señor Centeno have been so full and exact that I am but following his footsteps in giving the details of the orography and geology of the volcano.

As already stated the upper border of the crater is oval, with a major diameter from east to west, and a minor diameter very slightly less in size nearly at right angles. The highest point is

on the south-east side, about 1,000 ft. above the level of the sea. From this point it descends on the north-east and east-south-east to less than half the altitude mentioned. It then rises to the north to a height of about 785 ft. On the north-east side there is a crest with steep sides terminating in an extinct crater named Pinag Ulbuan, of an elevation of about 600 ft. It is about 400 yards in diameter, with a deep channel on the north-east side leading to the lake. On the north side of the island between the volcano and the sea, there are six or seven ridges of ash, and about the same number of mountain peaks, the most important of which are Ragatan and Matas-na-Golod, both between five and six hundred feet above the lake.

Between the volcano and the north-west angle or Cape named Binintiang Malaki, there is an interval of about 700 yards, and then the surface rises abruptly into an ancient crater called Balantoc, which is the largest of all the extinct craters, and about half the size of the present active basin. It was evidently at one time a central point of activity. It is elliptical in shape, about 350 ft. high on its eastern side, and with a channel or gorge on the west leading down to the lake. The interior of this crater is very abrupt on the north side, and less so on the south. It is all covered with dense jungle of a kind similar to that described in the crater of Binintiang Malaki, with whose ash deposits those of Mount Balantoc mingle. To the south of the mountain there is a series of small craters called Las Canas. They are seven in number, at least that number have pretty well defined circular forms, but there are others of irregular outline, which seem to have been partially destroyed as new ones were formed. The name Las Canas is derived from the shallow pans which are used in this part of the country for boiling sugar.

It need scarcely be said that, with a soil composed of loose pulverulent ash and fragments of scoriæ, cinders and pumice of every size, water would not rest upon the surface, especially as the slopes are so highly inclined for the most part. In the wet season the rain easily cuts down the loose materials of the sides of the active crater. Thus I noticed in going to the edge several

deep crevasses or dry water-courses of very rugged and broken appearance, with a certain amount of tangled jungle in the bottom. The inhabitants get water from wells near the side of the lake, though, as already observed, the water in the lake itself is only slightly brackish. In Australia we should consider such water quite serviceable for all domestic purposes.

Geology.—The exterior slopes of the volcano are of uniform character, composed of volcanic sand, scoriæ, breccia, tufa, alternating in strata of diverse thickness and different colours. I was surprised to see the difference there was between the colour of the soil and the appearance of the volcano from a distance. It was yellowish-brown when near, with fragments of yellow, black, and white rock. At a distance it appeared grey. There was the strongest contrast between the nature of the walls of this crater and that of Bromo in Java. The latter had crater walls of loose grey ash so fine that one sank into it ankle deep in ascending the slopes. There were, of course, larger fragments of stone and scoriæ, but the general character of the ash was exceedingly fine. Bromo continually emits a roaring noise, which is like a succession of violent explosions, which follow each other with such rapidity as to mingle the vibrations. These explosions, I have no doubt, are the cause of the fine fragments or dust into which the cinders of the volcano are blown. At Taal, on the contrary, there is scarcely any sound, and there are not consequently the detonations and explosions causing the fine rain of volcanic dust. The greater part of the slopes of Taal volcano, and especially on the north side, is covered with a fine stratum of ash decomposed into alluvium. In the lower portion there are large trachytic blocks, especially on the east and south-east sides. In the "Barrancos" or gullies already spoken of, scoriaceous lava streams of very hard dolerite can be perceived. I append at the end of this paper a description of the various minerals which are met with on the slopes of the volcano. This list, which is that of Señor Centeno, will afford me an opportunity of mentioning any details or observations which may be necessary.

Binintiang Malaki.—This, as already stated, forms the north-western prolongation or angle of the island. It is a small mountain in the form of a truncate cone. It has been beyond all doubt a true crater and point of ejection. Its slopes are highly inclined, and end precipitously in the lake on the north and north-east side in the deep waters of the lake. In order to ascend to the summit, one must land at the bay Panipihan on the north side. This gives an easy approach to the easterly slopes, which are gradual and admit of easy ascent. The crater is formed of regular strata of lapilli. At the base of the slope on the north side there are certain traces of the former volcanic activity in the form of small jets of gas which gush out below the water close to the margin of the lake. These gas jets are of such a high temperature that the water near them raised the mercury in my thermometer to 130° of Fahrenheit. Señor Centeno gives a temperature of 75 Centigrade, but this I suppose would depend upon the position of the thermometer with reference to the jet of gas. The water near the jets was very pungent to the taste. On the north side of the crater its height is about 500ft. above the level of the lake. From the north to the south the margin rises in the form of an amphitheatre to a height of about 850ft. above the lake, and 350ft. above the plain. The crater is about 300 yards in diameter, and is covered with vegetation. At certain seasons of the year a small portion of the base is cultivated, and some of the more hardy descriptions of rice, or those which bear a dry soil, are grown on the more level ground. The vegetation has already been referred to. The grass most abundant was *Imperata arundinacea*, the lalang or jungle grass of the whole of the Malay Archipelago. There is a deep barranco cutting down the crater to the edge of the plain, and serving to drain the water which falls into it in the rainy season. There are no remains of volcanic activity in the bottom of the crater, but there is a crack on the south-east edge of the summit, which emits abundance of white vapour. From this point to the plain the soil is covered with a thin white crust, under which the earth is black, and so hot that, at a few inches beneath the surface, it rises to within a few degrees

of the boiling point of water. At the bottom of the crater the soil is composed of detritus, which the rain has washed down from the sides. Señor Centeno considers that the great steepness of the north side shows that the volcanic activity ended in that direction, at any rate it proves that it was greatest on that side.

Ancient craters of Balantoc and Las Canas.—Between the active volcano and Binintiang Malaki there is, as already stated, another crater. It is much less elevated than the last, though considerably wider. The whole is covered with abundant vegetation, and the rocks are much more decomposed than the last. Moreover, there is not the slightest trace of any activity still going on. It seems to belong to the very early history of the volcanic activity in the island. Everything about it seems to indicate an older crater. To the south of Balantoc and separated by a deep watercourse about 40 ft. wide, is the curious region already referred to as Las Canas. It consists of a number of small craters close to one another or breaking-in upon one another, and covering about 500 acres of ground. Two of these are larger than the rest, with a diameter of four or five hundred yards, and about 120 feet high. Their sides are very steep, covered with hardened clay and vegetation at the base. To the west and north west there are others of similar dimensions. To the north-east of this region there is a fissure which is evidently due to weathering. The interior walls of the cavities known as Las Canas are extremely abrupt, and composed of cinders. To the north-west there is a horse-shoe-shaped platform a little raised above the level of the lake which forms the origin of a deep barranco scooped out by the drainage of water in the rainy season. I quite agree with Señor Centeno in attributing this kind of basin to weathering, and not volcanic activity. For the rest we must suppose that the portion of the island now described was at one time, but not for long, an outlet for the volcanic disturbance underneath. It is difficult to account for the history of all these points of ejection, or the order in which they appeared, but they are not difficult of explanation in a general way. Of course the

area of volcanic disturbance or the subterranean fires is very large, extending, as it does, for fifty or sixty miles in a straight line, and in some places of almost equal width. Now in a volcanic eruption many a fissure and many a fiery jet become covered up and obliterated by the immense fall of ashes and cinders, but, of course, only to break out in some new direction close by. The one central point is the volcano, but even this is full of little craters inside it, as we shall see presently. One is disappointed at seeing so little of the fires, but they are so completely covered with ashes and scoriæ, that sulphurous vapours and steam are the only evidence that we see of what is going on underneath. Every now and then a more powerful explosion casts the light and porous covering of cinders into the air, but the most of this falls back again and the vapour goes on escaping as before. What we see at Las Canas is similar to Vulcano in the Lipari Isles of the Mediterranean, in which, by the shifting of the centre of volcanic activity along a line of fissure, a series of overlapping volcanic cones has been produced.

It will be seen subsequently that there is reason for believing that the whole of the lake around the volcano is an area of subsidence, which represents the former extent of an immense volcanic cone. We have, therefore, according to this theory, only a portion of the later history of the volcano revealed to us, with the evidence of those forces which have tended to modify the form and character of this volcano, which, according to Mr. Judd's classification, is one of composite character. In his Work on Volcanoes he points out (p. 161), that the sides of such cones are liable to be rent asunder from time to time, and the fissures so produced are injected with liquid lava from below. These fissures rent in the sides of volcanic cones often reach the surface, and eruptive action takes place, giving rise to the formation of a cone or series of cones upon the line of fissure. Such small cones thrown up on the flanks of a great volcanic mountain are known as parasitic, and, though subordinate to the mountain mass, they are sometimes themselves of considerable dimensions. Amongst the hundreds which stud the flanks of Mt. Etna, there are some nearly 800 ft. high.

Between Las Canas and Binintiang Munti there are only the two elevations spoken of already as Mt. Tabaro and Mt. Saluyan; the rest of the plain is composed of slopes of ash, modified by barrancos which have been due to weathering.

Binintiang Munti.—This is a small ancient crater, so much worn down by weathering as to be only about 50 or 60 ft. above the level of the lake, and limited on its north-east and south-west sides by two small ridges, which are the remains of what was once the much more elevated rim of the crater. It has a depression in the centre, and is of horse-shoe form, about 500 yards across at its widest point. The slopes of this small cone terminate in the lake, with undulations on the surface giving rise to a number of small points which afford excellent sections. These display in a very complete manner the different strata which have arisen from eruptions at various times. One sees that the crater is built up of tufas and conglomerates of various colours and fineness, of very distinct character. Señor Centeno gives a list of these various deposits, but, on comparing his list with some of the sections exposed, I found they were subject to great variation, even in the space of a few yards; that is as far as colour and consistency were concerned.

Pinag Ulbuan.—It only remains to refer to one more of these subsidiary craters. This is the one spoken of on the north-east side of the island as Pinag Ulbuan. It is nearly circular, and about 350 yards in diameter, surrounded on the north and west sides with almost precipitous cliffs, and barred on the east by a dyke between 20 and 25 ft. high, which dams the water, and gives rise to the name of Pinag Ulbuan, which means in the Tagalo dialect a deep reservoir. The highest points of this crater are on the north-west and south-east sides, and are about 500 ft. and 400 ft. high respectively above the level of the lake. The aspect of this crater is that of an amphitheatre broken down largely on one side. There are good sections, which show the composition of the slopes to be of ashes, scoriæ and conglomerates, with volcanic sand in strata of different colours.

Before proceeding to the consideration of the interior of the great crater it is desirable to summarize the evidence which is afforded us by a study of the geology of the island. First of all it will be observed that there are two lines of volcanic fissures, made manifest by the shape of the island and the dispositions of the craters. The first is from south-west to north-east, beginning with the extinct crater of Binintiang Munti, and ending at the north-east cape of Pirac Piraso. Along this line, which passes through the highest portion of the central volcano and the most of its extinct craters, we have a line of ancient craters, which from their appearance would lead one to believe that they are also the oldest of the island. These are Binintiang Munti, Saluyan, Tabaro and (omitting now the central craters) Pinag Ulbuan, Ragatan, and the islands in the Seno de Hog Hog, which appeared to me to be very much like the remains of an ancient crater.

At almost right angles to this line of fissure there is another line, which would take in Las Canas, Balantoc, and the cone of Binintiang Malaki on the north-west. The second line of fissure would appear to be of a more modern character. I think a careful study of the volcanic evidences here exposed must throw some light on the chronology of these different basins, and possibly also upon the great question as to whether there has been a large subsidence where the present laguna now stands. It should be remarked that the greatest diameter of the lake corresponds nearly with the first described line of fissure, and also with the greatest prolongation of the volcanic tufas and trap-rocks.

Interior of the Great Crater.—I now proceed to describe the features of the great centre of activity in this island. First of all I shall give the impressions made upon my mind by a first view from the brink. The effect was certainly very wonderful and startling, so different indeed from anything I had ever seen before that it amazed me with most bewildering sensations. The first thing that strikes one, of course, is the source and origin of all the clouds of white fumes which are always rolling upwards out of the crater, and make it so conspicuous wherever seen. These vents

look rather smaller than one would anticipate from the great clouds of white smoke which unceasingly issue from the mountains. Still they look large enough and very significant of the volcanic forces below. The next thing which attracts the notice, is the extraordinary variety and vividness of the colours on the rocks, and in the lakes. First of all there is the large irregular shaped basin of bright emerald green water, extending like a pond at least half way round the crater. This forms such a strong contrast with the sulphur flat of lemon yellow, golden and orange. In the centre of the basin there is an extinct crater forming a somewhat smaller lake of pale bluish green water, which is like a turquoise set in copper, for this is the aspect of the purple-red crater walls nearly all round. To the left of this and underneath the highest part of the crater walls, are the two smoking craters, and above this the steep slope of the wall is all smoking, and quite yellow with a sulphur incrustation. The walls themselves are stratified in coloured lines of pale yellow and brown. This however is by no means uniform, for there are gaps, crevices and landslips where the ash has fallen down, and these are purple and brown or darkish blue. It would be almost impossible to describe the number and variety of the coloured stains upon the walls, all of them suggesting a fiery or a smoky origin, but yet very unlike the action of any ordinary fire with which one is familiar.

This was the state of the crater at the time of my visit, which was probably two and a half years after that of Señor Centeno, and though the general features of this basin have not changed much in the 300 years during which Europeans have been acquainted with it, yet there are some modifications, which we can gather from the different accounts that observers have furnished us with. This will be seen from the following extract from the notes of a geologist made about thirteen years previous to the time of my visit.

"In the same province is the Taal volcano, in the centre of which there is a small lake, the waters of which are charged with sulphuric acid. In the centre of the Laguna de Bombon, there is a small volcanic island with a crater of no great height and

about a league in circumference. From the midst of this there always rises an immense column of whitish fumes. The edge of the crater is easily reached, and one looks down an appalling depth. At the bottom is a small pond about 70 yards wide, from which the fumes are exhaled. The waters are a dark green, and encrusted all round with deposits of sulphur, soda, lime and magnesia. The interior is rugged but firm, and forms almost a natural staircase down to the water which can be reached with a little careful climbing. It is the most accessible crater in the world, and offers hundreds of sights to the traveller. The interior surface is seen to be composed of lava, cinders, fine sand, pumice and great quantities of sulphur and crystalline salts of soda, magnesia and lime. When seen from the edge they have a yellowish colour, and every now and then they are thrown into violent ebullition, accompanied by a roaring noise. From the bubbles caused by this spasmodic boiling, dense white fumes emerge, and these form the column of vapour which is seen from afar rising from the crater."

If this description was taken from actual observation, which I am inclined to question, though it occurs in the "Boletin de la Comision del Mapa Geologica del 'España, Vol. III," the change which has taken place in the crater since 1872 is very great. No mention is made of the two small smoking craters, and there is only one lake spoken of instead of three which I saw. The description of Señor Centeno comes nearer to the state in which I saw it first, but still there are differences. At the early part of his visit descent into the crater seemed so difficult that it was only undertaken with many precautions in the way of ropes and other aids. He describes, first of all, the reddish yellow lake which occupied all the north-east part of the crater. Its margins were covered for fifty or a hundred yards with abundant concretions of various colours, yellow, red and white. These consisted of sulphur, oxide of iron, alum and gypsum. The sulphur was crystalline or encrusting; the iron oxides formed a film more or less thick arising from the decomposition of the scoriæ. Alum and gypsum were present in large handsome crystals. The gypsum was in thin tabular crystals disposed vertically and horizontally upon one

another. The margin of the lake, which is alternately washed and left dry, was a soft and steaming mud full of little fumeroles of vapor in places with the temperature of boiling water. In other places the mud was white with a temperature of about 100 degrees. Every now and then this lake came into a state of slight ebullition, during which time the surface bubbled, throwing up small quantities of mud a short distance above the surface. Señor Centeno was unable to ascertain the depth as the margin cannot be approached except on one side. It appears to be very deep, with a temperature of about boiling water. The taste was acid and astringent.

This was much the state in which I saw the lake except that the signs of ebullition were very faint, and the whole appeared to have cooled down considerably since the visit of the Spanish geologist. The accompanying map with a dotted line will show the track of Señor Centeno which I followed to some extent, except that I did not go so far round the yellow lake. He surrounded all the southern margin of this lake to the point N, on an extremely rugged and narrow path between the walls of the crater and the water. From this he returned to the point A, following the interior walls of the second crater, reaching the point B, which is a truncated cone with a base about 130 yards wide and 25 yards deep, with almost vertical walls and exactly like the small craters already described at Las Canas. From thence he went to the edge of the blue-green lake marked C, and then to the point D, from which the sulphurous fumes issued forth from a small crater. Either the point G or H in his map, was also contributing abundance of fumes at the time of my visit, so there had been an alteration to that extent. He speaks of a small cone with a circular crater surrounding this fumerole composed of cinders, but there was nothing of the kind at the time of my visit. There were six broken, half-formed craters like Las Canas ; one great slope encircling half of them on the south-side composed of red ropy looking scoriæ. On the side of this was an almost smooth, yellowish-white, muddy surface, in the midst of which were two round pits out of both of which dense white

fumes were rising in intermittent clouds with a faint murmur like boiling water. The width of one of these pits was about 20 yards, and of the other about 40 yards, but I only judged of these from a distance: they were perhaps 100 yards apart.

As I have already stated, the interior of the walls was tinted with all sorts of colours, very much like a furnace or a kiln on a gigantic scale. They were composed of loose ashes and scoriæ, but sometimes molten together and twisted like splashings of furnace clinker on a large scale. There were great bosses of sulphur and other minerals, probably gypsum or felspar or lime, but it would be a very long business to describe the whole of the appearances along the sides of the crater. The whole of this heterogeneous mass of rock—as Señor Centeno well expresses it—is broken up and confused by landslips, deep cracks, and loosening of the strata, produced sometimes by the rains, by interior emanations and explosions, or finally by great earthquake shocks, to which the crater must be exposed at periods of unusual activity.

The following is an analysis given by Señor Centeno of the water of the yellow lake :—

Analysis.	*Grammes.*
Sodium chloride	15·9412
Potassium chloride	0·7095
Iron chloride	4·1907
Iron sulphate	0·5693
Aluminum sulphate	0·9360
Magnesium sulphate	1·3200
Lime sulphate	0·5100
Free sulphuric acid	1·5855
Silica	0·6400
Sodium phosphate	0·5867
	26·9889

The above was the result of an examination of the solid contents obtained by evaporation of one litre of the water. I have two other analyses from different authors, which differ only slightly from the above.

Señor Centeno mentions the mode in which the phenomenon of ebullition is manifested at this part of the crater. There was a periodical boiling up about the centre of the waters, which were raised for the time being into a kind of jet, from which mud and clay were thrown out with a noise like the boiling of a cauldron. This must be due to a periodical escape of gas, somewhat similar to what is taking place in the smoking craters.

Green Lake.—At the time of Centeno's visit the green lake was absent or possibly merged in the yellow one, but it was by far the larger in 1885, and in fact the yellow lake seemed only a shallower prolongation of it, with a margin of sulphur and felspathic mud at the time of my visit. The green colour was, as I have said, intensely vivid. The waters were singularly still, but in Centeno's time they were continually emitting sulphurous vapours. The margins were precipitous on all sides, and higher on the south-east, making it impossible to get near enough, with the means at my disposal, to obtain any specimens of the water. It will be seen presently that there was another green lake, which was the only green one visible in Centeno's time. But, in comparison with the large surface of vivid emerald green water with the yellow margin, its waters looked quite pale. The two basins of green water, both of large extent, and of such different tints, could not of course have escaped the observation of the Spanish geologist had they existed in his time, but he makes no mention of them. The bright emerald green lake formed a portion of the yellow lake, according to his map. The change of colour, especially so remarkable a change, is singular and interesting. It may possibly be accounted for by supposing that, as the gaseous emanations had ceased, the sulphurous mud had subsided, and left the natural colour of the water to appear.

Bluish-green Lake Crater.—The colour of this lake was, in 1885, about the same as that of the sea in moderate depths, where the blue colour is not decided. The tints seemed beautiful to the Spanish geologists, but by the side of the brilliant yellow and green tints of the other waters it seemed poor in colour. In 1883,

vapours were continually ascending from its waters. Its margins are precipitous on all sides, but higher on the south-east, where I should say they rose between 80 and 90ft. high and almost vertical. It was full of mineral water, with a temperature which appeared to be almost boiling. The sides of the lake were covered, in 1883, with crystals, but I saw nothing of the kind, and the water was not steaming, but apparently still and cool. It would require a very long cord to reach the water, at least longer than any I possessed, so that I could not obtain specimens. Señor Centeno was more fortunate; he obtained some after a little difficulty, He says that though of a deep green at a distance, in the bottle it was of a very pale colour. The taste is more acid, bitter and salt, than the water of the yellow lake, and gives a much more abundant precipitate on evaporation. The following is the result of an analysis made by the official chemists at Madrid :—

Analysis.	*Grammes.*
Sodium chloride	30·8588
Potassium chloride	3·4716
Iron chloride	9·6736
Lime sulphate	0·4644
Magnesium sulphate	3·0600
Iron sulphate	1·6772
Sodium phosphate	0·7620
Silicic acid	0·7400
Free sulphuric acid	1·4888
Free hydrochloric acid	7·8264
	60·0228

This was, as in the former instance, the result of an analysis of one litre of water. The proportion of solid matter is unusually large, and the amount of chlorides quite extraordinary.

Red Crater.—Near to the green lake there is a circular crater, about 400 ft. in diameter and 70 or 80 ft. deep, with almost vertical walls. It is filled with volcanic detritus and scoriæ of a fiery red colour, and, during the rainy season, it is said to be filled

with water of a similar tint, which contrasts with singular brilliancy with the neighbouring lakes. My visit being at the end of an unusually long dry season did not permit me to see any water in this crater.

The Spanish author whom I have followed hitherto, here describes an active cone about 300 metres to the south of the green lake. He says it is a small but very perfect cone, composed of ashes and scoriæ, with a circular basin, from which emanate continually those unceasing clouds of white vapor which render this island so conspicuous. This cone, he says, can be approached to within 50 or 60 yards. It is about 50 ft. high, with a diameter for the crater of 18 or 20 ft. There was, he says, a constant murmur, like that of the boiling and bubbling of some viscid liquid, which could be heard 500 or 600 yards away. Presuming that this is the larger crater from which the white fumes continually emanated at the time of my visit, it has changed very much in appearance. I should say that this has been due to a constant rain of fine dust and sulphur which had levelled this crater, and quite changed its conical outline. In fact, the fumes seemed to me to be coming out of a pit that was more like a well than a cone. Since the last eruption which took place, the whole of these features have been subject to new and extensive alterations. The vapor was liable to great variations in the manner in which it came forth from the pit, sometimes it was in thick white masses forming quite a canopy over the crater, at other times there was only a thin veil of smoke. Some authors have thought that these intermissions depend upon barometric pressure. It is quite certain that there are days when the smoke is unceasing, and others when the volcano can scarcely be distinguished from the surrounding hills.

It may be added that the whole of the interior of the crater was more or less smoking at the time of my visit. The cracks and crevices which sent forth continuous jets of white sulphur fumes were quite beyond numeration. The whole face of the interior slope on the highest side was thickly studded with these

jets from top to bottom. Wherever they occurred a little efflorescence of yellow colour could be also seen.

The track which leads down to the crater, or rather the tracks, for there are two, were well beaten, as if they had been well used by many travellers and by the Indians. They were made of zig-zag shape, so that there was not the slightest difficulty nor danger in either ascending or descending. I noticed in many places by the side of the track, small sulphur fumes, and, as I have already mentioned, an iron point thrust into the ground showed that at no great depth it was red hot. Since the last eruption no doubt all these conditions have changed, but I was told by one of the Indians that the slope of the sides was still the same. In any case, supposing that there was no change, I should strongly advise any tourist never to descend alone into the crater, even with guides, for the dangers, though not very apparent, are really very great. The heat and vapours are, at best, almost overpowering, and a very slight change of the conditions might intensify both to an extent incompatible with the existence of human life. Such changes must be constantly occurring even in the most tranquil periods of the volcano's history.

Barometrical measurements prove that the level of the waters in the crater is about the same as the level of the lake. It would be difficult to suppose any connection between the two. Señor Centeno suggests that the waters are entirely due to the internal drainage during the long and heavy rainy season in this locality, and that the heat causes them to have a strong chemical action, dissolving the felspars, sulphates, and chlorides, with which they come into contact. The heat of course is supplied by the volcano. Something of this kind must be the true explanation, but one is at a loss to know why similar phenomena are not seen in other lake craters. The crater of Bromo, in Java, is perfectly enclosed, but there is no accumulation of water at the bottom, and other instances might be cited. Usually extinct craters are full of water, and this is the origin of some of the most beautiful lakes with which the surface of the earth is adorned. "As crater-rings are usually composed of materials more or less impervious to

water, they often become the site of lakes. The beautiful circular lake of Laach, in the Rhine Provinces, with the numerous similar examples of Central Italy—Albano, Nemi, Bracciano, and Bolsena—the lakes of Campi Phlegræi (Agnano, Avernus, &c.), and some similar lakes in the Auvergne, may be adduced as examples of crater-rings which have become the site of lakes."

"One of the most beautiful of the crater-lakes in the Auvergne is Lac Paven, which lies at the foot of a scoria-cone, Mont Chalme, and is itself surrounded by masses of ejected materials. The crater-lake of Bagno, in Ischia, has had a channel cut between it and the sea, so that it serves as a natural harbour. The lake of Gustavila, in Mexico, is an example of a crater-lake on a much larger scale."

"In many of these crater-rings the diameter of the circular space enclosed by them is often very great indeed as compared with the height of the walls."

"Two of the largest crater-rings in the world are found in Central Italy, and are both occupied by lakes, the circular forms of which must strike every observer."

"The Lago Bracciano, which lies to the north-west of Rome, is a circular lake six and a-half miles in diameter, surrounded by hills, which at their highest point rise to the height of 1,486 ft. above the sea, while the surface of the waters of the lake is 540 ft. above the sea-level. The Lago di Bolsena is somewhat less perfectly circular in outline than Lago di Bracciano; it has a length from north to south of ten and a-quarter miles, and a breadth from east to west of nine miles. The surface of the waters of this lake is 962 ft. above that of the waters of the Mediterranean. The lake of Bolsena, like that of Bracciano, is surrounded by hills composed of volcanic materials; the highest points of this ring of hills rise to elevations of 684, 780, and 985 ft. respectively above the waters of the lake."*

But if these lakes are distinguished for anything, it is for the singular purity and clearness of their waters. Without citing other instances, I may give one which belongs to Australia,

* Judd on Volcanoes, p. 171.

and which is the type of many other extinct craters in the colony of Victoria. This is the series of lake-craters of Mt. Gambier in the colony of South Australia, forming a piece of enchanting scenery, which has won an almost world-wide reputation. I have already, in my "Geological Observations in South Australia,"* given a description of the blue lake, which is a perfectly enclosed basin, about half-a-mile wide, with precipitous sides and a varying depth between 200 and 300 ft. The waters are a dark blue like the open ocean, but they are perfectly pure and limpid, without any excess of solid constituents, unless it be that of lime.

This is the more extraordinary when we reflect upon it, for usually in lakes that have no outlet, concentration of salts, due to evaporation, gives rise to well-marked chemical characters in the water. The small amount of water does not exactly explain this, because there must be a very considerable quantity in the crater of Taal. No matter what eruptions and changes have taken place, as soon as things get a little settled the lakes are always there in one shape or another. They are always referred to by every historian, though differing in number and shape and sometimes in colour, there has been always a general resemblance, which marks them out as distinctive features of this volcano. They are generally confined to one side of the basin, and usually occupy much the same limits. If they were derived from surface drainage during the rainy season, why are there not waters in all the extinct craters, such as Las Canas? But the soil is too porous for rain waters to rest upon it, and there are scarcely any surface accumulations at any part of the island.

For my own part I am inclined to think that these lakes owe their origin to some peculiarity in the emanations of this crater. Volcanoes vary very much in their products. There are some volcanic centres from which only one kind of lava has been emitted, but there are others in which the changes in the material thrown out are as unceasing as they are unaccountable. Water is always an accompaniment of whatever is emitted from volcanic vents. Water of course in the form of steam. "Along with this steam

* London, Longmans 1863, 8vo, 404 pp.

the most common substances emitted are two gases, sulphurous acid and sulphuretted hydrogen. When these two gases come into contact with one another, chemical action takes place, and the elements contained in them—oxygen, hydrogen, and sulphur—are free to group themselves together in an entirely new fashion; the consequence of this is that water and sulphuric acid (oil of vitriol) are formed, and a certain quantity of sulphur is set free. The water escapes into the atmosphere, the sulphuric acid combines with lime, iron, or other substances contained in the surrounding rocks, and the sulphur builds up crystals in any cavities which may happen to exist in these rocks."—(Judd's Volcanoes, page 19.)

Without propounding any new theory, there must be something special in the nature of the underground rocks which causes them to manifest themselves in the peculiar features of this crater. The quantity of sulphur in it seems quite exceptionally great, as well as the chlorides, and these are quite sufficient to account for the large quantities of hydrochloric and sulphuric acid which are found combined with the waters.

There is another important question connected with the craters of Taal, to which the Spanish geologist has given much careful consideration. This is with regard to the former history of the volcano, and to the theory which accounts for the lake of Bombon by supposing that it occupies the site of a much larger volcanic mountain which has been submerged. A short review of the arguments relied upon is in every way worthy of attention.

First of all Señor Centeno points out the wide extension of the ash deposits or tufas which seemed grouped around this volcano as a centre, shows it to have been the principal focus of volcanic activity in the southern part of the island of Luzon. The tufaceous strata extend all round the lake to the sea, except on the eastern side. Northward they entirely cover the strip of land between the Laguna de Bay and the Bay of Manila. They also entirely cover the country round the capital, and then are found extending north as far as the town of San Ildefonso. This immense deposit of volcanic cinders and dust which is known to geologists as

the tufaceous region of the volcano of Taal, attains to considerable thickness in certain localities, with a distinct structure in its cinders and pumice according to the extent and duration of the various volcanic eruptions. In making the excavations connected with the Manila Waterworks the tufa has been sunk through for nearly 30 feet. The section showed that the different strata were separated by a deposit of fine volcanic sand, which marked the period of comparative repose in the eruption. There are, of course, many other extinct volcanoes in the region now referred to, such as Banajao, Majajay, Maquilin, and many others on the side of Laguna de Bay. But some of these have not been in activity within recent times, yet it is thought possible to assign to each whatever share it may have had in producing the tufaceous deposits. This will be considered by some to be open to question, but, at any rate, there can be no doubt that a very large quantity of ash deposit has come from the volcano of Taal, and that this quantity is largely in excess of what can reasonably be attributed to the present crater.

The physical geography of the Laguna of Bombon is an argument which is also relied upon. It is separated from the sea by only a very narrow strip of land, and this is entirely composed of ash deposits. The lake itself is brackish, and has an extensive marine fauna in its waters. They said that sharks are found in it to an extent which prevents the natives from venturing into its waters at any distance from the shore.

It is hard to see how these facts can be regarded as settling the matter one way or the other. Supposing the lake to have been separated from the sea by the gradual filling up of a narrow strip of land through which the river Pansipit now flows, the appearances would be still the same. As to the fishes, it is a well-known fact that sharks will ascend fresh-water rivers for a considerable distance, besides other marine fishes. The fishes that I saw amongst the inhabitants of the lake were fresh-water Siluroids, and the mollusca were decidedly fresh-water, including the genera *Melania*, *Paludina*, *Unio*, *Cyrena*, and *Corbicula*. The same species are found in the Laguna de Bay.

However, it is fortunate for the theory that it does not depend for its support on such reasoning. It has a much more powerful, and, to my mind, convincing support from the present configuration of the sides of the lake. There we find that its margin is in very many places formed of high cliffs, sixty or seventy ft. in height, and in a few localities, such as Macolod, &c., the waters are confronted by precipices between 2,000 and 3,000 feet high. To quote from Señor Centeno: "If we observe Mt. Macolod with a height of 966 metres and the rapid slopes of its sides toward Cuenca, and its equally sudden breaking off at the water's edge, we cannot help seeing that we have here only a fragment of what this original mountain has been, and that some extraordinary change has taken place since it was deposited in strata of ash. If we observe the opposite portion of the laguna we shall see that the cordillera called Tagatay—which is the limit of the lake to the north, and is terminated on the east by Mt. Sungay—has meridional slopes of rapid inclination, which terminate in escarpments on the side of the lake; such, for instance, as Mahabangbato in the village of Banga, in Balit-Biring and in Kalukan. In the precipitous escarpments one can see clearly the horizontal stratification which shows an abrupt breaking off of the slope, which at one time extended uninterruptedly from the top of the mountain to the Bay of Manila."

Señor Centeno has carried these considerations a little further, and has speculated on what must have been the former height of this mountain. By prolonging the slope from the Bay of Manila to the Pico Ilong Castila, a distance of about 20 miles, and from thence continuing the projection of the same inclined plane in a south-east direction, while on the opposite side of the lake the slope between Cuenca and Mt. Macolod is projected in a north-west direction, the two lines will meet over a point in the lake about 3 miles to the eastward of the present crater. This would give a height to the former volcano of about 12,500 ft. above the level of the sea, a height which is almost exactly that of Semiru in Java, and the well-known Fuji-San or Fuji-Yama in Japan. The whole of the details of this calculation are most interesting, and bear upon

the face of them a stamp of probability which is fully warranted by the facts of the case.

The theory receives new support from what has been recently observed in connection with volcanic eruptions, and a reflection on what really takes place during their continuance. It must be obvious that such immense deposits of tufa can only have been supplied by the transfer of enormous quantities of material from below. The cavities and chasms thus caused in the course of time must have been so great as to defy calculation. Just imagine the amount of material scooped out from great depths to cover the surface for nearly 100 miles north of Taal, and 10 to 30 miles wide. It would be hardly possible for so much of the lower portions of the earth's crust to be taken away without subsidences and failure of support in some direction. When even the much more moderate subterranean excavations of our mining operations cause land-slips and extensive subsidences, how much more likely is it to anticipate some failure of support from the unceasing activity of a volcano. There is little doubt that it was to some such cause as this that the catastrophe of Krakatoa owed its origin. That island-volcano had been belching forth for months unceasingly rock-material in the form of ashes and scoriæ, until the land for more than 100 miles, and much of the intervening sea, were strewn thickly with them. At last it would seem that the cavity thus arising allowed full entry of the sea to the innermost depths, where the subterranean fires were raging. Hence the awful explosions which were heard in terrific distinctness 900 miles away ; hence the concussions which disturbed the very foundations of the earth, until at last the earth's crust collapsed, the island-crater toppled over and fell in, and the regurgitation of the water carried dreadful destruction on to the neighbouring lands in the form of tidal waves. The island-crater of Krakatoa was partly submerged and disappeared. Fragments of the crater-walls, now raised in broken and precipitous faces to 1,500 ft. and more above the waters, are memorials of the way in which the volcano was torn and split asunder, but where its highest wall stood is now marked by 100 fathoms of ocean.

It is no far-fetched or unreasonable hypothesis, therefore, to suppose that this has been the history of the volcano of Taal, and this has been the way in which the lake of Bombon has been formed. The broken sides of Mount Macolod and the other portions of the lake all attest the violence of the catastrophe, while the depth of the lake itself shows us something of the dimensions of the mountain which sunk down. As I sailed round the bay in the lake called the Seno de Lipa, I had a good opportunity of closely examining the precipices at Punta Calinana, where the structure of Mount Macolod is fully exposed. The strata are disposed in such regular order and with such a uniform dip, that one cannot resist the conclusion that we see in them a fragment of the steep sloping walls of an immense volcanic cone.

In order to examine and test the hypothesis more closely, I left Point Caluit early in the day and coasted over to the opposite shore, and then poled round the lake close to the margin, except where it was too precipitous for the boatmen to do so. I passed round the Punto de Lipa between Napayong Island and the shore. I expected to see in the latter island some traces of the former slope of the volcano continued in the stratified rocks visible here. It will be seen, however, that Napayong Island owes its origin to a former sub-lacustrine eruption within historical periods, and, of course, subsequent to the disappearance of the ancient cone. However, I was not able to ascertain this in a satisfactory manner. Many of the cliffs of Napayong are covered with a thick vegetation of creeping vines and the usual tropical foliage. The cliffs are absolutely inaccessible, and I do not think it would be possible to examine them satisfactorily on both sides of the lake without a considerable expenditure of time. My boatmen, who did not relish exposing their canoe to the full force of the evening breeze, would not give me the time I wished, so I had to content myself with an examination of the rest of the coast from the island to San Juan, on the north side of the laguna. All I saw was confirmatory of the theory that the lake of Bombon now occupies the site of a former and much larger volcano. I consider that the evidence falls but little short of absolute proof, and that the height of

the submerged mountain, according to the reconstruction of Señor Centeno, is a reasonable theory, and one which accords in a satisfactory manner with the evidence.

It is a singular fact that one of the most respectable of the historians of the Philippines should have taken this view of the history of the Taal volcano. In the "*Historia de las islas de Philipinas compuesta por el R. P. lector Fr. Joaquin Martinez de Zuñiga,*" the following passage occurs :—"There are in this island several volcanoes as that of Mayon, which is between the provinces of Albay and Camarines. It has a sugar-loaf figure, and is of such altitude that it may be discovered at an immense distance at sea. The de Taal is of a similar form and stands in the middle of a large lake called de Bombon ; it exhibits sufficient proof that the mountain in whose top the volcano was, has sunk, remaining, however, still pretty much elevated above the water."* In giving Zuñiga credit for this theory, it must be added that he was not the author of the book which bears his name. He was an Augustinian monk, selected probably by his order to edit the papers of a deceased friar, whose name has not come down to us. The work was published in 1803, but it concludes with the ratification of peace in Manila, and its restoration to the Spanish Government by the English in 1763. The real author evidently concluded his chronicle at that date, and it was not until nearly 50 years afterwards that the Augustinians resolved on its publication. The friar, whoever he was, had visited the volcano, for he says in the 12th chapter of the 2nd. volume—"In the commencement of the government of Don Pedro Manuel de Arandia, in the month of December, 1754, there happened a terrible shock of an earthquake, and the Taal, which is in the middle of the Lake Bombon in the province of Batangas, threw out such an immense quantity of cinders, as completely to ruin four towns which were situated near the lake, and the inhabitants found it necessary to retire a league further into the interior. Many other severe shocks followed, accompanied by loud reports similar to those of contending squadrons,

*It is not generally known that there is an English translation of this work by John Maver, published in London in 1814, by the booksellers to the Hon. E. Ind. Co., Leadenhall-street.

and the atmosphere was entirely obscured by the sand and ashes thrown up by the volcano, so that at Manila, which is twenty leagues distant, it was scarcely possible to see even in the middle of the day, and at Cavite, which is rather nearer, the obscurity resembled the darkness of midnight.

"I ascended with the Señor Alava to the summit of this volcano, but all that we could observe was a lake about half-a-league in diameter, very deep and containing water of a dark green colour."

It is much to be regretted that the chronicler who gives us so much detail of other interesting facts connected with the Philippines, did not think this volcano of sufficient importance to tell us a little more about it. An accurate topographical description of the state of the crater 130 years ago, would have cleared up many points that are doubtful now. A few measurements would have enabled us to make some estimate of the relative growth of the cone which probably would carry us on to some facts connected with the date of the disappearance of the old mountain. It is interesting to note, however, that the green lake has existed for so long a period, and from this we may conclude that the features of the crater are of considerable antiquity. If the mention of this solitary fact is of comparative value where other details are entirely wanting, we have more reason to regret the silence of Fray Martinez de Zuñiga.

With regard to the date of the submersion of the ancient crater of Taal, the Spanish geologists are not entirely without expectation that something may yet be discovered which will throw light upon the matter. Of course when a date is spoken of it is meant to refer rather to the unknown quantity of a geological period than to any of our own solar computations of time. Manila has recently been supplied with water from the country, and the works connected therewith have necessitated extensive excavations in the vicinity of the city. It was hoped that the sections thus exposed in the volcanic tufa beds would have revealed some animal and vegetable fossils. These would certainly throw some light at least on the geological period of the eruptions. It is stated that the superintending engineer of the works, Don

Genaro Palacios, gave strict orders to his subordinates to search for any animal remains, and to preserve them with the greatest care, but unfortunately no such fossils were found. Vegetable remains, however, were discovered in some abundance, consisting of trunks of trees more or less perfectly silicified, and unmistakeable impressions of leaves and branches. All the specimens were found to belong to the existing flora, and Señor Centeno adds, that in connection with these fossils, not the faintest trace could be identified as referable to the human period or rather, as he expresses it, "to the hand of man."

This however is a conclusion which is not borne out when the fossils are attentively considered. Some of the leaves were those of an introduced plant, that is to say, a cultivated plant not belonging to the Philippine flora. The specimens enumerated are some silicified trunks of *Streblus asper* (Louriero). This is an unarmed tree or shrub belonging to the mulberry section of the Urticaceæ, originally described by Fr. Louriero, S.J., in his "Flora of Cochin-China." There is but one species, which is confined to tropical Asia, extending from Ceylon and the Indian Peninsula to the Malay Achipelago, the Philippines, and Southern China. There is nothing peculiar about this plant connecting it with the wants of man, and it is never cultivated. It is common in the Philippines, as far as my observation goes, and I have seen it also as a small tree growing in Java. The silicification of the trunks of these trees is no evidence of great antiquity. A few years will sometimes completely petrify a trunk or a stem. There is a specimen in the Brisbane Museum in which a fence rail has been completely converted into flint, and in it there is a long iron nail which is known to have been driven into the wood less than 40 years ago.

Another plant which has been identified, is surrounded with a considerable amount of interest. This is *Psidium guayava*, Raddi, or the common guava so well known by its aromatic fruit in tropical countries. Now this is undoubtedly a plant which does not belong to the flora of the Philippines, and it has most certainly been introduced into them by the hand of man. The home of the

guava has been a matter of controversy, but the question has been confined as to what part of tropical America or the West Indies it belonged. It has been pretty well decided, however, that it came from the south portion of the continent. Probably there are few plants which germinate so easily and so rapidly, and it fructifies usually in the third or fourth year; its area has thus spread, and is still spreading, by naturalisation in those tropical countries which are neither very hot nor very damp. There are about 60 species of the genus *Psidium* known. Their fleshy and somewhat aromatic fruits especially attract frugivorous birds, which carry their seeds to places far from cultivation. There is scarcely any fruit which germinates so easily, and requires such little care in its cultivation. I. Acosta, in the "Histoire Naturelle et Morale des Indes Orientales et Occidentales" (French translation, 1598, p. 175), tells us that in mountains of San Domingo and other West Indian Islands the land was entirely covered with guavas, and he adds that the natives said that there were no such trees in the islands before the arrival of the Spaniards, who brought them. De Candolle, in his "Origin of Cultivated Plants," (p. 241), from whence I have taken the above quotation, gives references to Hernandez, Piso and Marcgraf, all early historians of New Spain, The Brazils and Peru, to prove that the guava was not known until the Spaniards discovered America. The name of the guava is probably Peruvian, and was formerly guajavos or guajava.

There can be very little question, therefore, that the guava was brought to the Philippines by the Spaniards, and it could hardly be growing wild or widespread in the islands until the close of the 16th century. This would give a very recent date to the tufas in which the fossil leaf impressions were found. I have no particulars as to where, or in what numbers, the specimens were discovered, nor how deep down in the ash deposit. We may presume that they were not deep down, and that they belonged to some of the destruction caused by the most recent eruptions of the volcano.

This brings us to the question as to what was the state of the volcano when the Spaniards first took possession of these islands. First of all it must be remembered that Luzon was not the earliest

colonised island, nor probably was it seen, except at a distance, at the time of the discovery of the group in 1519. Manila was founded in 1571, but we do not find any detailed account of the island for more than 100 years after that. It is said by Señor Centeno, though he does not cite any authorities, that there are ancient documents in existence which would seem to indicate, though not in a very reliable manner, that the volcanic activity was, at the time of the Spanish conquest, confined to the north-west extension of the island in the now extinct crater of Binintiang Malaki. So recent an activity is hardly borne out by the appearance of the rocks, but inasmuch as there are still some signs of eruption visible, such as the emanation of gases, steam and heat, the thing is just possible. We know from experience how very rapidly these subsidiary craters form and disappear. To cite no other instances, the parasitic cones of Etna and Ischia are good examples of this sort of formation.

When at the end of the 16th century, says Centeno, the principal towns of the province of Batangas were founded, there did not exist amongst the inhabitants of those localities any tradition worthy of credit, of eruptions or notable cataclysms from this volcano. If there were such they have not been registered in historical documents. The most ancient chronicle that he was able to consult was that written in 1680, by Dr. Fray Gasper de San Agustin, preserved in the ancient library of the Augustinian monastry at Manila. I visited this establishment, which is one of the splendid architectural curiosities of the city, and whose library, church, and traditions are historical monuments of extraordinary interest and value. Through the kindness of the Provincial, the muy Rev. Padre Fray Felipe Brabo, and the Rev. P. Fray Raimundo Lozano, the Definidor of the order, I was able to visit the library, and make some investigations amongst the valuable chronicles which they possessed. It is not of much importance to cite the whole of the quotation from Fray Gaspar, who relates the precautions taken by the parish priest of Taal to deliver the inhabitants from certain supernatural inconveniences which were supposed to be connected with the volcano of Taal. The important

points in this chronicle are the facts given as to its actual state in 1680. Padre Alburquerque, parish priest of Taal, states that he went to the edge of the volcano, which had within its crater two principal mouths—one of sulphur and one of green water, which was always simmering, to which many wild deer came for the sake of the salt which was found on the edge of the lake. This testimony is important as showing what was the state of the volcano at that time, and how comparatively tranquil it was. Since then, it would appear, there has been very little alteration in its features, except that it has grown more active. At that time also we learn that the slopes of the island were cultivated in places by the natives, the crops being algodon or cotton, and camote or sweet potatoes. The chronicle further relates how the minister of Taal, Padre Fray Tomas de Abreu, with the assistance of 400 Indians, erected upon the summit of the crater a large wooden cross formed of a hard wood named *Anobing (Artocarpus)*, and that afterwards the fields, which had become quite sterile, returned to their former fertility, and that the volcano was not for a long time known to cause any disaster amongst the inhabitants.

Our author states that he has not been able to meet with any other notices, except those indicated, anterior to the eighteenth century. During this it appears to have been the custom for the parish priests of the neighbouring towns to register in a manner more or less detailed and exact, the principal eruptions of the volcano. Thus, in the "*Relation of that which happened in the volcano of the Laguna of Bombong*," written in Bauan, on the 22nd December, 1754, Padre Fray Francisco Bencuchilo speaks of two eruptions which took place in 1709 and 1715, accompanied by loud subterraneous thunders, and a casting forth of red hot stones, and a great fire, which, like a river, flowed all over the island, destroying everything in its course and yet not causing any damage to the towns situated on the margins of the lake, but limiting its action entirely to the small volcanic island.

This statement, if it be taken to mean that lava streams flowed from the volcano during the eruption, has nothing to confirm it in the island. None of the craters seem to have given rise to anything

of the sort. The Spanish geologist mentions that, in some of the deepest barrancos, doleritic lavas are exposed, which he refers to the most ancient eruptions connected with the volcano. On referring to my notes I can find no appearance of anything of the kind except at Binintiang Malaki, where there is something like a stratum of true basalt, but the vegetation prevented my being able to trace it accurately. This, at any rate, could not have been the lava stream to which the worthy friar refers. It is most probable that the appearances described were due to the slipping down from the slopes of large quantities of red hot ashes. I noticed a similar effect on the sides of the crater of Semiru, in Java, when in full eruption. The whole mountain seemed aglow at night time, as if the point of it was red hot, and every now and then there were slips and refts, avalanches in fact amid the ashes. This, at a distance, gave an appearance of movement exactly like streams of fire.

I find on referring to the article Volcan in the *Diccionario Geografico Estadistico de las islas Filipinas por el P. Buzeta* (which through the kindness of Padre Mauricio Blanco, of the Augustinian Convent, Iloilo, Panay, who obtained a copy for me, I am able to refer to now), that a graphic description is given of an eruption which took place in 1716. It seems to have had its origin about the Punta Caluit on the south-eastern side of the island; at least this is what is said by the recording eye-witness, but a reference to the map will show that this part of the island is quite free from any traces of a crater or other focus of activity. I had a good opportunity of examining this part of the island, as we kept very close to it in our canoe. The eye-witness referred to was Padre Francisco Pingarron, then parish priest of the town of Taal, the main points of whose description are as follows :—

On the 24th of September, 1716, at 6 o'clock in the evening, they suddenly heard loud sounds like discharges of heavy artillery which came from the direction of Manila. Shortly afterwards the fiery glow which comes from the island volcano, seemed to be directed to that portion which was nearest to the town of Lipa, that is the island cape called Calavita, which appeared to be a

mass of fire. Subsequently the fire seemed to involve the lake in the direction of Mt. Macolod, causing an enormous bubbling or jets of water and ashes, which rose continually into the air, causing much fear and terror, especially as this was accompanied at the same time by great earthquakes agitating the water of the lake into high waves such as a hurricane might have produced, which beat against the shore with such force as to remove many fathoms of it, and endanger the safety of the convent. This state of things continued during Thursday, Friday, and Saturday until Sunday, on which day the worthy Father says—all the material of nitre, sulphur, &c., which occasioned the fire was pretty nearly consumed. The waters had meanwhile become quite hot, destroying immense numbers of fishes both large and small. These were cast upon the shore by the waves, and, with the odor of sulphur, created such a terrific effluvium that the inhabitants of the neighbouring town were threatened with a pestilence. When the sun came out for a few moments on the Sunday, it was seen that the waters of the lake were as black as if they had been dyed, which caused the greatest terror; but, to use the words of the pious chronicler, "it pleased God in His infinite mercy to restore tranquillity to the elements, and all that remained was the oppressive odor of so many dead fish."

In 1731, says Padre Bencuchillo,* the effects of volcanic activity made themselves once more manifest in the lake, and the result was such an agitation of the waters and a casting up of mud, sand, and ashes from the bottom, that some islands were formed, and these are thought to be those of Bubuing and Napayong. At least Señor Centeno thinks so, but the Augustinian monk says that the formation took place opposite Punto Calavita, where, as already stated, there are no traces of local volcanic action, and where the lake is of great depth.

**Relacion de lo sucedido en el volcan de la Laguna de Bombong, escrita in Bauan en 22de Diciembre de 1754.* I must mention that I am entirely indebted for this reference and quotation to Señor Centeno's pamphlet. I have never seen the work myself, which, however, is cited by most of the subsequent writers on the topography of the Philippines.

It would seem as if these volcanic disturbances at the bottom of the lake must belong to some subaqueous crater. The locality of them is in a prolongation of the line of fissure which extends from Binintiang Munti through the main crater by Mt. Pinag Ulbuan to these islands. From the repeated disturbance of this part of the lake we may reasonably infer that this is one of the main foci of volcanic activity, and is in fact a point corresponding with what must have been the highest centre of the ancient and submerged crater. The present crater is considerably to the westward of this point, and probably is quite insignificant in comparison with the old volcanic vent. The excessive discharge from this centre is probably the explanation of why it has subsided the deepest. The fires may now be diverted entirely to another channel, as so long a period has elapsed since there has been any renewal of the disturbance in that direction.

From 1731 there were 18 years of comparative quiet; but in 1749 there took place one of the most severe eruptions of which there is any record since the arrival of the Spaniards in the Philippines. At that date the parish priest of a neighbouring town was Padre Bencuchillo, "a man of observation and fond of these kind of studies," who took care to witness as much as he could of this eruption, and of the greater one in 1754, and wrote a detailed account of what took place.

At 11 o'clock at night, on the 11th of August, 1749, the first indication of the eruption was a brilliant glow over the summit of the volcano. This was followed at three in the morning by continued detonations, which lasted until dawn. An immense column of smoke began to roll forth from the crater, with hundreds of other little pillars from different parts of the island. From the surface of the water of the lake there rose what the chronicler describes in this and other places as perfect obelisks of sand and mud, which, he states, reached certainly above the clouds, and then spread out and fell back into the water. These jets, which came forth from the depths of the lake, appeared in two principal directions, one to the north and the other to the east of the volcano. At nine in the morning violent earthquakes commenced, and as the

appalling jets of water and sand into the heavens began to come closer and closer to the shores, the inhabitants fled into the hills. After a second series of earthquakes a large portion of land near the town of Sala was submerged beneath the lake, leaving nothing visible but the tops of the trees. The force of the eruption continued with all its primitive violence for three days, during which time the air was so darkened by ashes that the lamps had to be lit by day in the houses. After the third day there was a mitigation of the force of the eruption, which, however, continued unusually active for three weeks, and then the crater was comparatively quiet for a while, but the volumes of smoke which came forth from it were dense and unusual, and remained so for the succeeding five years.

Until 1754, the year of the great earthquake of Grand Cairo, when half the houses and 40,000 people are said to have been swallowed up, Taal remained quiet, but on the 13th of May of that year it broke out again. This was the greatest eruption that was ever known there. For seven months, or rather until the 1st of December—that is 200 days—the fiery mountain was in awful activity. Up to this time the settlements on the fertile slopes of the lake-margins had not suffered much damage, that is until the eruption of 1749, but now ruin and desolation spread over the land with great loss of life. The towns of Sala, Lipa, Tamanan and Taal, with their numerous and rich hamlets, were entirely destroyed, while far and near devastation spread over to the most remote portions of the province, such as Balayan, Bauan, Batangas, Rosario, Santo Tomas and San Pablo. These regions, I can bear testimony, may be called the garden of Luzon, and though they have now recovered completely the effects of the catastrophe of 130 years ago, yet then it was said they were converted into a desert. The principal violence of this eruption seemed to have been confined to the ejection of enormous quantities of cinders, which, so to speak, made the whole ground red hot, and repeated the appearances of torrents of fire. The easterly wind took these over the hamlets and agricultural districts dependent upon the towns of Taal and Tanauan, and completely destroyed them, not

only by the quantity of cinders, but by the heat of the fiery rain. This was followed in the month of June by showers of black mud, together with the ashes, while night was made horrible by the fearful sounds, or the kind of infernal glow of fire, flame, and volumes of sulphurous smoke. The observer who gives the account of it, kept his ground in the town of Taal, though the greater portion of the inhabitants had fled. All the months of July, August, and part of September the volcano continued to emit, with more or less intensity and slight intermissions, great flames with dense volumes of smoke. On the 25th and 26th of September the shower of ashes was so heavy that the few remaining inhabitants had to leave the houses, lest they should be crushed by the falling roofs. From the same cause everything in the way of vegetation was utterly destroyed. The whole of the months of October and November were occupied by new manifestations of fiery activity, with an increase of the deafening roar. On the feast of All Saints, the first of November, there was a marked increase of the disturbances, but on the 27th the fury seemed at its height. New fiery mouths were opening out at every moment, until the island seemed to be one mass of flames, which appeared to penetrate the clouds. The earthquakes and the explosions were really terrific, and the fiery and muddy rain was becoming of such increasing danger that the Padre and the last remaining inhabitants took refuge in the mountains, which they only succeeding in reaching after incurring innumerable perils. The 28th of November was another awful day, and on the morning of the 29th they perceived new jets of vapour in various parts of the island between Point Calavita and the crater in a straight line, as if a new fissure had been opened between those two points. The Alcalde and the Padre, who had returned to Taal to contemplate the ruins which were there, had to fly again to the mountains, for the last great effort of the eruption had begun. At four o'clock in the afternoon the horizon began to be hidden by utter darkness from a steady rain of mud, ashes and sand, not in great quantities at first, but unceasingly through the whole of the night, so that in the morning there was on the ground and on the houses nearly half-a-foot of the results

of this shower. There was not much time given them to observe it, for the whole scene was soon enveloped in an extremely dense and thick cloud, which in an instant shut everything out of view with so thick a darkness that absolutely the people could not see their hands. All was horror and fright. It was impossible to light a fire or a torch; in an instant it was extinguished by the copious shower of mud that fell. We are reminded in reading this of the destruction of Herculaneum and Pompeii, and of the palpable darkness described by Pliny. We can well understand the Padre saying that all was the saddest image of night that one could ever behold, all were sunk in despondency while the Indians toiled unceasingly to free the roofs of their houses from the mud, lest they should be buried alive under them. No one thought of eating or sleeping, but only longed for something to dissipate the darkness so that they might take to flight. Others stood free and yet prisoners, for no fetters ever bound the feet so effectually as this thick obscurity. There was not the slightest ray of light visible, and thus in the midst of the day it was the deepest night. At four o'clock in the afternoon the rain of mud ceased somewhat, and at four leagues from the laguna in the sanctuary of Caysasay it was found to have accumulated to a depth of about four feet, while in places nearer to the volcano it was nine feet in depth.

On the 1st of December this dreadful rain of mud and ashes ceased; but, to fill up the measure of the poor Indians' misfortunes, on the next day a terrible hurricane broke over the island, laying in waste and in ruins all that the volcano had spared.

To this awful eruption succeeded a long period of quiet, or at most of very slight disturbance. Fifty-four years after what we have just related, in the month of February, 1808, there was another manifestation of extraordinary energy which continued until the month of April of the same year. The eruption was confined to a discharge of cinders, but without any disastrous consequences to the people dwelling on the margins of the lake, which have been almost entirely re-populated though the towns of Sala, Lipa, Tamanang, and Taal, have never been rebuilt. There is a town of Taal, but it is much nearer the sea.

On the 17th of May, 1874, there took place an eruption of black mud and cinders, unaccompanied by earthquakes either before or after. On the 19th of July of the same year, there was another eruption with dense sulphurous fumes, the characteristic odour of which was inconveniently felt by the inhabitants of Talisay.

On the 24th of June, 1877, earthquakes were felt from one to half-past six in the morning, but they were not followed by any eruption.

From the last days of October, 1878, to the 12th of November, subterranean noises were frequently heard proceeding from the volcano. On the date mentioned there was an eruption which lasted until the 15th, and covered all the island with a thin coating of ashes, but without any earthquakes either before or after.

On the 8th of June, 1880, greater activity than ordinary was observed in the volcano. For some nights there was a bright glow over the crater, which continued with slight interruption until the middle of July. On the 17th, 18th, 19th, 20th, and 22nd, subterranean noises were heard, and from time to time a small globe of fire was thrown up out of the crater, which burst at a certain height above it.

Finally there was an eruption in 1885, to which I have referred. About the month of September, volcanic disturbance commenced and continued for some months; great damage was done by the fall of ashes, and all the cattle on the island were destroyed. I visited the neighbourhood, and found a most complete scene of desolation in place of the fertility which had formerly reigned. The inhabitants had been so alarmed that they had fled in considerable numbers from Talisay and the villages on the margin of the lake, but there was no loss of life. On some future occasion I hope to give further details about this eruption, but at present some promised data and details from Spanish eyewitnesses have not come to hand.

In conclusion a few words may be said about the peculiarities of this volcano. Owing to the absence of any well-exposed lava streams there is no means of ascertaining whether this crater gives effective support to the views enunciated by Baron Richthofen.

I mean the theory which he propounds as to the order in which volcanic products make their appearance. According to this author, the first erupted rocks are those of intermediate composition known as Andesites. These Andesites, which are especially characterized by the nature of their felspar, sometimes contain free quartz, and are then known as quartz-andesites or dacites from their abundance in Transylvania, the old Roman province of Dacia. Richthofen suggests that another class of volcanic rocks to which he gives the name of "propylites" were in every case erupted before the andesites, and in support of his views adduces the fact that in many instances propylites are found underlying andesites. But the propylites are, in chemical composition, identical with the andesites, and, like them, present some varieties in which quartz occurs, and others in which that mineral is absent. In their microscopic characters the propylites differ from the andesites and dacites only in the fact that the former are more perfectly crystalline in structure, being indeed in many cases quite undistinguishable from the diorites or the plutonic representatives of the andesites. The propylites also contain liquid cavities, which the andesites and dacites as a rule do not, and the former class of rocks, as Prof. Szabo well points out, are usually much altered by the passage of sulphurous and other vapours, in consequence of which they frequently contain valuable metallic ores. The extension of these andesitic lavas is sometimes accompanied, and sometimes preceded or followed, by eruptions of trachytic lavas—that is, of lavas of intermediate composition which have a different kind of felspar from that prevailing in the andesites. In the final stages of the eruptive action in most volcanic districts the lavas poured forth belong to the classes of the rhyolitic or acid, and the basaltic or basic lavas.*

The author from which the above is taken, goes on to tell us that this law is admirably illustrated in the Lipari Islands. The great central volcano of this group, now in a ruined condition, is composed of andesitic lavas. The other craters disposed on three

* Judd, Volcanoes, op. cit., p. 199.

radiating lines of fissure are composed of andesite and trachyte. All the recent ejections of the volcanoes have consisted of rhyolite or basalt.

As I have said there are no proper lava streams from which this can be studied. The Spanish geologist considers that in the lowest formation or the basal foundation of the island, there are true lava streams of a basaltic character. This would mean that the earlier eruptions, or rather those which built up the island after the subsidence of the great crater, were accompanied by outflows of lava. From this point of view the whole history of the present crater is very difficult to unravel, but without entering into the matter it may be sufficient to say that what evidence this volcano offers, though it is but slight, is in favour of Richthofen's theory. The general character of all the emanations is basaltic and doleritic. Trachyte is, however, found in a few places, as for instance the island of Napayong, and about Mount Sungay in a barranco close to the town of Talisay. I shall subjoin to this essay the list given by Señor Centeno of the minerals which he has met with, premising that I have not been able in every case to verify the references, or visit the localities. I may mention also that there is a trachytic rock visible at Binintiang Malaki, but no rhyolites, andesites or propylites as far as I have been able to make out.

Catalogue of the Rocks of the Volcano of Taal and of the Mountains in the vicinity of the Laguna of Bombon.*

1. Sulphur crystallized and in concretions. Volcano of Taal, bottom of the crater on the north-east border of the yellow lake.

2, 3, 4. Crystals of gypsum surrounded by a nucleus, probably vegetable, which has disappeared and has been replaced by sulphur. The specimens also contain alum. Ditto.

5. Crystals of gypsum. Ditto.

*In the following list the numbers up to 74 are from the district of the town of Talisay, 75 from Lipa, 76 to 79 from Cuenca, and 80 from Taal.

6. Gypsum in tablets. Volcano, bottom of the crater between the two lagoons.

7. Concretionary gypsum impregnated with alum. Volcano, bottom of the crater east of the yellow lake.

8. Domite, impregnated with alum.* Interior of the crater.

9. Laterite.†

10. Basalt, somewhat scoriaceous. Ditto.

11. Wacke, (earthy basalt? in which traces of retinite or pitchstone are observable). Ditto.

12. Spongy basaltic scoriæ. North edge of great crater.

13. Basalt. Ditto.

14. Volcanic breccia. Ditto.

15. Basaltic lava. Ditto.

16. Volcanic tufa. Ditto.

17. Ditto. Central volcano, escarpments on north and north-west.

18. Ditto. Localities—north margin of the crater and Binintiang Malaki.

19. Basalt covered with a crust proceeding from the decomposition of the rock. Pinag Ulbuan.

20. Superficial crust covering volcanic detritus. Central volcano, the highest portion of the island.

21. Ditto. Interior of the crater of Balantoc.

22. Dolerite with magnetic iron affecting the compass. Volcano, and Binintiang Malaki.

23. Scoriæ. Volcano and Binintiang Malaki.

24. Mimosite (?). Volcano and Binintiang Malaki. Declivity of the crater.

25. Grey-stone (Graustein) of Werner. Volcano and Binintiang Malaki at the foot of the declivity.

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*Domite. By this term I presume is understood a kind of trachyte with a large proportion of silica not in the form of quartz but tridymite.

†Red earthy matter with much per-oxide of iron resulting from the decomposition of lava.

26. Lapilli. Volcano and Binintiang Malaki.

27. Conglomerate of sand and ashes, with a nucleus of dolerite. Volcano, Binintiang Malaki, wall of the crater.

28. Trachytic Breccia. Volcano, Binintiang Malaki at the base.

29. Laterite. Volcano, Binintiang Malaki. Point Baclas.

30. Tufa with red ochre. Volcano and Binintiang Malaki in the crater.

31. Wacke and laterite. Ditto.

32. Volcanic conglomerate of recent ashes. Ditto.

33. Volcanic grits. Volcano, Binintiang Munti, western slope top of an escarpment.

34. Volcanic tufa. Volcano, Binintiang Munti, western slope.

35. Doleritic lava, somewhat scoriaceous. Volcano, Binintiang Munti, eastern slopes.

36. Trachy-dolerite. Ditto.

37. Doleritic lava. Ditto.

38. Basaltic lava. Volcano between Mapulang-Bato and Binintiang Munti.

39. Dolerite. Ditto.

40. Doleritic lava. Ditto.

41. Doleritic lava, reddened by magnetic iron. Volcano, Mapulang-Bato.

42. Basaltic lava. Ditto.

43. Basaltic scoriæ. Between Point Calavita and Mapulang-Bato.

44. Doleritic lava with magnetic iron. Ditto.

45. Basaltic lava. Volcano between Point Catan-catangan and Point Calavita.

46. Scoriaceous basalt. Ditto.

47. Doleritic lava, largely porous and scoriaceous. Ditto.

48. Doleritic lava, ditto and at Point Catan-catangan itself.

49. Basalt. Volcano on the borders of the great crater.

50. Tufa composed of fine constituents. Escarpment of Point Baloc-baloc (close to Pinag Ulbuan).

51. Oolitic volcanic tufa. Ditto.

52. Volcanic sandstone. Ditto.

53. Basaltic scoriæ. Ditto.

54. Basalt somewhat scoriaceous. Ditto.

55. Very recent tufa. Escarpments of Point Cayasa*

56. Volcanic grits. Between Points Baloc-baloc and Bignay.

57. Doleritic lava. Barranco between Mata-na-Golod and Ragatan about the margin.

58. Scoriaceous tufa of grey and red color. Islands north-east of the volcano.

59. Volcanic tufa. Ditto.

60. Compact bed of scoriaceous ashes. Islet of Bignay, north of the island Bubiun.

61. Volcanic tufa. Bubiun.

62. Basalt. Ditto.

63. Basalt somewhat scoriaceous. Ditto.

64. Basalt. Napayong Island.

65. Trachyte with streaks of basalt. Ditto.

66. Laterite. Ditto.

67. Very compact volcanic tufa. Ditto.

68. Trachy-dolerite. Mt. Sungay, Pico Gonzalez.

69. Compact volcanic tufa. Ditto.

70. Retinite. Mount Sungay, Barranco adjoining Talisay.

71. Trachyte. Ditto.

72. Porphyritic trachyte. Mount Sungay, Banga barranco.

73. Laterite. Mount Sungay, Calocan Village, Escarpment of Balicbiring.

74. Dolerite. Point Lipa and Mount Macolod.

75. Dolerite, partly decomposed. Mt. Macolod.

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*I found in this deposit some small fragments of the common freshwater shells of the lake (*Corbicula crosseana*, Fisher).

76. Doleritic wacke. Ditto, Sabang barranco, upper part.

77. Volcanic tufa. Ditto.

78. Compact doleritic lava. Ditto.

79. Ditto, coarsely vesicular. Ditto.

80. Trachy-dolerite. Calangay Village on the left bank of the river Pansipit.

Catalogue of Plants on the Volcanic Island of Taal.

During my stay upon the island and crossing the Laguna of Bombon, I made a collection of more than 100 plants, which was augmented through the kindness of friends who had collected in the same locality, to more than 230 species. Señor Centeno has published at the end of his pamphlet a list of 236 species which were collected on the island between 1877 and 1879. They were determined by Padre Fray Celestino Fernandez Villar, an Augustinian monk, who, with Padre Andrea Naves, edited the new and magnificent edition of Padre Immanuel Blanco's "Flora Philippinensium." I find, on comparing my list with that of Señor Centeno, that it includes many species overlooked by his collectors, while I did not succeed in obtaining some that are mentioned in his list. I shall therefore combine the two, and shall add such remarks concerning the various species as will include some of the botanical notes during my eastern travels.

RANUNCULACEÆ.

1. Naravelia zeylanica, DC., called Banai-banai by the Tagalo Indians. This is an inconspicuous climbing plant with star-like yellow flowers distinguished from Clematis by the presence of petals. It is the only species, and extends all through the Eastern Archipelago, being known by the name of Narawael in Ceylon. I have found it in shady humid places in many localities where I have been botanizing in Java, Malayan Peninsula, &c. The plant is acrid, but I am not aware whether any medicinal properties are attributed to it by the natives.

DILLENIACEÆ.

2. Delima sarmentosa, L. (Tetracera), another climbing plant widely distributed in eastern tropical Asia, including Ceylon, Burmah, Malayan Peninsula, Java, Southern China, and the Philippine Islands. The upper surface of the leaves is completely covered with little hard asperities, which are so rough that the leaves are used (as also many kinds of fig-trees) as a substitute for sandpaper. The Visayan and Tagal Indians call the plant Mala Catmon, Mala signifying dry or juiceless, and Catmon a species of *Dillenia*, which, though yielding an acid fruit, is eaten by the Indians. This species is the only one in the genus; the others included by the older authors are confined to America, and belong to the genus *Doliocarpus*. The name *Delima* is derived from delimo, to file off, and in Ceylon the name Coroswael is from corossa to smooth.

MAGNOLIACEÆ.

3. Michelia champaca, L. The celebrated tree of the east, famed for the perfume of its flowers with which the natives adorn their heads, the scent and the elegant orange color of which forms a contrast with their black hair. In cultivation throughout the East, where in India, the Archipelago and the Philippines, it is universally known by the name of *Champaca*. Said to be derived from an island off Cambodia named Ciampa and Tsampa, of which the tree is a native. It is cultivated as much in China and Japan as in India, and for the same purposes. In the former country it is called Yeung-kau-nga, in Mandarine Yang-kau-ya, in Japanese Kinkoboku. I am doubtful whether this is cultivated on the volcano island; but, in a set of plants sent to me, some garden plants from the Barrios or villages round Taal were, I suspect, included.

ANONACEÆ.

4. Anona squamosa, L. Sweet Sop or Custard-Apple. Native name Ates, meaning a softening or digesting. Vellozo, a Spanish writer, says the name Ata is evidently borrowed from Attoa and

Atis, which are those of the same plant in Asia, and which belong to eastern languages. From this St. Hilaire infers that the Portuguese transported this plant from their Indian to their American possessions. It has been a matter of much controversy, whether the custard-apple is of Asiatic or American origin. Several claims have been put forward for different parts of Asia, even including the Philippine Islands, where it certainly has been cultivated from the earliest European colonization. The whole question can be seen in De Candolle's "Origin of Cultivated Plants," and it can hardly be doubted that the fruit originated from America, and, probably, the West Indian Islands, but there are no other true Anonas indigenous to Asia, though there are some in Africa. In connection with this fact, a rule which it is well to bear in mind, is mentioned by De Candolle, namely, that no tree, *except littoral species*, is known to be indigenous at once to tropical Asia, Africa, and America.

5. Anona muricata, L. Sour Sop, Custard Apple. There is no controversy about the introduction of this species, which is the largest and, by many, considered the best It is much valued for flavoring ices.

6. Anona reticulata, L. This is the species named custard-apple in the West Indies, while all through the East it goes by the name of Bullock's Heart. Where proper attention is not paid to its cultivation it is small, tasteless and gritty, especially in Java. The finest fruit I have seen is at Malacca. The chirimoya is not, strange to say, cultivated in the East.

7. Uvaria purpurea, Blume. Banuac, in Tagalo and Visayan, also Susong-calabao, the second name referring to cow's milk. This beautiful purple flower with clusters of yellow fruits (edible?) like plums, is very commonly met with in the jungle throughout the Indian Archipelago.

MENISPERMACEÆ.

8. Tinospora crispa, Myers. Macabuhay, Tagalo, which, I am informed, is equivalent to *revivifying* or *resurrection*. This climbing shrub is found throughout India and the Archipelago, and known

by the name of Galuncha to the natives of the Indian Peninsula, who attribute to it many medicinal virtues. It does not appear to be similarly appreciated in the Philippines, though it is by the Malays. We have two species in North Australia nearly allied to the Asiatic one, but the leaves are rather differently shaped, and the fruits much smaller.

In the 'History of Drugs of Vegetable Origin,' by Messrs. Flückiger and Hanbury, there is an elaborate microscopic examination of this plant.

9. Anamirta cocculus, Wight et Arnott. Balasin, Tagalo and Visayan; Andorualli, Bali Island. Furnishing the seeds known as *Cocculus indicus*, used to give a stupefying influence to beer, and for intoxicating fishes. The latter use is well-known among the Malays. The poisonous principle is due to picrotoxine, and in the pericarp is found the no less formidable alkaloid Menispermine. I have met the species occasionally in the jungle through all the Malayan and Philippine Archipelagos.

10. Cissampelos paraira, L. Sansao, Tagalo; Sampapare, Visayan; Aroai-Astravulu, Java (Sundanese dialect). A very wide-spread plant found in all tropical regions, named from the climbing character of ivy (Gr. κισσος), and the clustered fruit of the vine (αμπελος); called by the Portuguese Pareira-Brava. It is doubtful whether this is not also an introduced plant. The Portuguese missionaries in the Brazils in the 17th century, were acquainted with a root to which great medicinal virtues were attributed, and which was named by the natives Abutua. It was brought to Lisbon, and thence in 1688 to Paris by Michel Amelot, ambassador of Louis XIV. Several plants of the same order have been confused with this species, which is but little employed now in medicine, though Sir Benjamin Brodie strongly recommends its employment in inflammation of the bladder.* Its efficacy is universally believed amongst the natives of the East.

*London Medical Gazette, 16th Feb., 1828.

CAPPARIDEÆ.

11. Gynandropsis pentaphylla, DC. Although Vidal's list of native names is very rich, comprising more than 1600 words, yet this plant does not appear to be represented in it. In Bali it is called Boangit. The genus has been united with *Cleome*. It was separated for this species and similar ones in consequence of a greater elongation of the receptacle, which becomes extended into a long and slender stalk. There is nothing otherwise calling for notice in the species, except that it is a tropical coast plant of India, Africa, and Asia. I have found it also in Celebes. There is a species in North Australia distinguished by the very large size of its flowers.

12. Polanisia viscosa, L. This plant is widely spread as a weed throughout the whole of the East, but especially in the Philippines, where in some places it goes by the Visayan-Indian name of Namoc or the mosquito; in Bali it is also called Boangit, and the leaves are eaten like mustard leaves in salad. In all Northern Australia the plant has become a perfect nuisance, and goes by the inelegant name of 'Stinking Roger.' It is common as a weed in Celebes, Amboyna, and Timor.

13. Cratæva nurvala, Forster. Balainamoc in Tagalo. A wide-spread plant extending from Malabar to the Society Islands, where it is regarded as a sacred tree, and planted in the gardens. In Java it is called Dangdur-Allas. In the East it is called the Sacred Garlic Pear, and is a small tree. I am doubtful whether this came from the volcanic island.

14. Capparis horrida, L. f. Native names Dauag, Alcaparras. The latter name is doubtless a corruption of Capparis. A white-flowered shrub with spinose stipules; widely spread throughout the East.

15. Capparis micrantha, Blume. No special name to distinguish this species which is spinose, but with small leaves, and generally a smaller plant. I have met with it in Sumatra and Java.

BIXINEÆ.

16. Bixa orellana, L. Achiote, a name given to it by the Spaniards, Roucou in French, Arnatto in English, Daun-Galingum in Malay. A cultivated plant introduced by the Spaniards from the north-west coast of Mexico, and extending down to the Brazils, where the name Uruku accounts for the French etymology. At the time of the discovery of America, it was used by the natives to stain their bodies red, and the Mexicans in painting. The Mexican name Achiotl is the origin of the Spanish term. The plant is highly valued at the Philippines, and much in use. It forms an agreeable condiment as well as coloring matter, especially in chocolate and pillaws of rice with "pimento," and in soups. It is valued also medicinally. No doubt it has warm stimulant qualities. On certain occasions the Indians still use it, mixed with lemon juice, to dye the skin. With alkalis the tint is changed to bright orange. The bark of the tree is in request for its fibre, and is used for a common sort of rope, while the soft tissue of the wood makes it a favourite material for procuring fire by friction. The juice is said likewise to be an antidote to the poisonous juice of the root "Manihot or Cassava." The drug Arnotta is prepared from the red pulp covering the seeds. This is extracted and macerated in a wooden vessel, with enough hot water to suspend the red pulp. By diligent stirring and pounding this is separated from the seeds, or gradually washed off with a spatula. When the seeds are clean they are taken out, and, when the wash is settled, the water is poured off and the sediment put into shallow vessels to dry slowly in the shade It is then made into balls and set to dry in an airy place till it is quite firm. Some first pound the fruit with wooden pestles; then steep them in water for six days. This liquor is passed through four series of sieves, and the result left to ferment for a week; then boiled until pretty thick, and afterwards made up into balls, and wrapped in leaves. Good Arnotto is fiery red, bright within, soft to the touch, and entirely soluble in water. See Don, Vol. I. p. 293. In a non-alkaline solution it is used to give leather particular tints.

17. Flacourtia sepiaria, Roxb. In Tagalo Bitongol; in Sundanese Seradan-caju, the latter name meaning wood in Malay. In Telegu it is called Canru, or at least the fruit which is sold in the market This is a red berry, dreadfully astringent when fresh gathered, but by keeping it acquires a pleasant acidulous flavour. It is thorny, and, therefore, used throughout the East as a hedge plant.

POLYGALACEÆ.

18. Salomonia oblongifolia, DC. A little insignificant weed which does not appear to have any native name in the Philippines, though the natives of Banka call it Jereme-auju. It is found in moist places in the warmer districts of India, from Ceylon and the Malay Peninsula to the Philippine Islands and Hongkong. I found it growing very thickly all over the European Cemetery in Labuan, Borneo. Its terminal spikes of minute pink flowers make it look like a heath.

PORTULACACEÆ.

19. Portulaca oleracea, L. The common purslane, which is naturalized in all the warm countries of the world. It does not appear to have any vernacular name in Luzon, unless that of Bonglay, which means a weed. In Sundanese and Javanese it is called Gelang. I never noticed that it was much eaten by the natives. It has acquired a melancholy interest from its being used so much by the lamented Australian explorers Burke and Wills as a means to stave off famine.

20. Portulaca quadrifida, L.

MALVACEÆ.

21. Malvastrum tricuspidatum, A. Gray, in Botany of American Exploring Expedition. This species of American origin is dispersed as a weed over all the tropical Asiatic regions. Its small orange flowers in waste abandoned places, remind one of the habits of the marsh mallow, the place of which it takes in habits and medicinal virtues.

22. THESPESIA POPULNEA, Corr. Waru-laut, Malay; Banago, Tagalo, also Boboi-gubat. This species is found all through the tropics of the East near the sea-side. Its large yellow flowers, and green shady leaves make it a conspicuous object on all coast regions. I have met with it everywhere in my travels, and it extends to Queensland. The wood is valued for gun-stocks, and though soft it never decays under water, whence it is much valued for the frames of boats. A rich yellow dye exudes from the large brown seed-vessel. It is also much used for fomentations, &c. Altogether it is a valuable tree, and will grow in the poorest sand. The tree however has to be avoided, for it is invariably alive with green and red ants.

23. SIDA HUMILIS, Willd. Daun-sassapo in Malay; in Tagalo, Mamolis, also Escobang. There are several species of this genus, which are common oriental tropical weeds growing everywhere in waste places.

24. SIDA RHOMBIFOLIA, L. This is the common species which is generally known in Australia as *S. retusa*, where it has become such a troublesome weed. It is said to be a native of N. America, but there is no question that it is indigenous in Australia and the East as well. The Acclimatisation Society get the credit of having introduced this pest, but it was in Australia long before any settlement of the colonies.

25. SIDA CARPINIFOLIA, L. Said to to be a native of Brazil and of the Mauritius.

26. ABUTILON INDICUM, G. Don, W. et Arn. Kadam-kadam, Malay. As in the case of many other plants I could not find a native Philippine name for this plant, which is common on road sides and waste places in all Southern Asia and tropical Africa, if anything most common in the Philippines. It extends to Queensland.

27. MALACHRA BRACTEATA, Cavanilles. Another wide-spread weed from South America, conspicuous for its white flowers with red centre and very hairy stem.

28. Urena lobata, L. A weed so widely spread throughout the East and as far as tropical Australia, that its pretty pink flowers form a considerable portion of the undergrowth of every jungle. Very variable in the shape of its leaves. It is called Latiang in Malay.

29. Hibiscus surattensis, L. Assam-tusur, Malay; Antolangan, Tagalo. A very prickly, wide-spread, straggling weed, which is probably indigenous; with yellow flowers and a dark purple centre. Leaves eaten for their pleasantly acid taste.

30. Hibiscus tiliaceus, L. A common small sea-coast tree of most tropical countries including Australia, particularly abundant in the islands of the Pacific. Flowers large and showy, yellow, with a dark crimson centre. In the Philippines the flowers are much esteemed for their medicinal virtues. At Amboyna it is called Haru.

31. Hibiscus rosa-sinensis, L. A plant in cultivation in almost every garden throughout the Philippines. Probably this is the species to which the Tagalo name Antolangan is given, but it is also called Mapola. The flowers are used for every purpose of adornment, to polish leather, and also, strange to say, by the women to blacken their hair and eyebrows. The Chinese call it Hung fa, using it on all festive occasions, particularly at funerals, where it is made into garlands to adorn the feast. The Japanese name is Bussonge.

32. Hibiscus esculentus, L. Gumamela in Tagalo. I am doubtful as to the habitat of this species, which is used so extensively in all the East, where it goes by the name of Gombo or Okro, but is not common as a vegetable in the Philippines. The young fruits of this annual are the most delicious of tropical vegetables, and their mucilage forms a useful thickening for soups. Where it originally came from has been disputed. It was claimed as belonging to the Eastern flora, but there are no ancient names for it, and no indication of an ancient cultivation in Asia. De Candolle, on the authority of Flückiger and Hanbury, quotes from an Arabic work showing that it was cultivated under the name of Gombo by the Egyptians in 1216. It came probably from more southerly African regions.

33. Gossypium herbaceum, L. Algodonero, a Spanish word which is in use by all the Indians; Malay in nearly all the dialects Kapas and Kabu-kabu, Kapase in Bengali, Kapas in Hindustani, all derived from the Sanscrit word Karpassi; Arabic Kutn, whence Coton and probably Algodon; Chinese (Punti), Min, Mandarine Mien; Japanese, Wata and Momen. Probably derived originally from the Malay Peninsula and Archipelago. Two exhaustive works have appeared on this subject lately in Italy, one by Parlatore,* and the other by Todaro.† The former admits seven well-known species, and two doubtful, while Todaro counts fifty-four, only two of which are doubtful, reckoning as species forms which originated in cultivation and are permanently preserved. *G. herbaceum* is the species most cultivated in the United States, *G. indicum* in China and Japan, but these determinations are doubtful. The natives of all the East from India to Japan, depend upon it as one of the great staples of agriculture.

STERCULIACEÆ.

34. Sterculia fœtida, L. Calumpang. Visayan and Tagalo; in Java Dangur-jedeh. This is entirely a coast-species ranging over the East Indian and Malayan Peninsulas and the Indian Archipelago, and extending to Australia. It has a most disgusting odor wherever the plant is bruised or cut. When the surveyors of H.M.S. Flying Fish were out marking, they were often much annoyed, when clearing their stations, by wounding this plant. The woody carpels are like three figs joined together at the apex, and, wherever these were seen abundantly strewn on the ground, we moved away. The oily seeds bring on nausea and staggering, while the leaves are aperient, diaphoretic, and diuretic. Wood indifferent, bark gives excellent fibre, and exudes a gum resembling tragacanth.

35. Kleinhovia hospita, L. Tanay, Tagolo; Bitnong, Ilocano dialect; Catimoho, Sundanese. This is a smooth tree spread over

* Monogr. delle specie d. Cotoni, 4to, Florence, 1866.

† Relaz. s. la coltura dei Cotoni in Italia, con monographia del genere Gossypium. 8vo. Rome, 1877.

the Indian Archipelago, the Moluccas and the Philippines. It has broad leaves and divaricate racemes of small pink flowers. When bruised or cut it emits a strong odor of violets, which the father of Dutch Naturalists, Rumphius, refers to in his work on Amboyna.

36. Melochia corchorifolia, Willd. Balitnon, Visayan; Pompuruten, Javanese and Sundanese. A weed which I have not seen very commonly in the East.

37. Waltheria americana, L. The species are mostly American, but this one, which is found in Australia, is very generally dispersed within or near the tropics all over the world.

38. Heritiera littoralis, Ait. Commonly called the looking-glass tree. Dungon, Tagalo, Atun-laut, Malay; Penglai-kana-so, Burmah. A large evergreen tree, common in all the tidal forests along the sea-shore from the Indian Peninsula to Australia. Wood brown, rather light and loose-grained, probably not occurring on the volcano island.

TILIACEÆ.

39. Triumfetta procumbens, Forst. An insignificant weed found in most islands of the Indian Archipelago and the Pacific within the tropics. The Malays in Java call one species Gut-jingam.

40. Corchoris olitorius, L. Visayan, Pasao (pigs' food); Jepon, Javanese; Isunaso, and Kanabikio (rope, cable), Japanese. The valuable Jute of commerce, indigenous to India, but now cultivated and naturalized in all the East, including the Philippines. The fibre of this plant is the most widely distributed production of India. There is not a town in Europe in which jute is not found in the form of ropes, lines, string, bags and paper. The fibre is derived from two species, *C. capsularis* which furnishes the sunn-hemp of commerce, and *C. olitorius* the fibres of which are employed to make the coarse stuff known as gunny or goni, the native name for the fibre on the Coromandel coast. This

species in Bengali is called Blunjee-pat; the other Ginatita-pat, and a wild variety called Bun-pat. The plant is cultivated in the Philippines. It is prepared by maceration in water and sun-dried. The trade is very considerable in India. Besides gunny-bags made from the bark, the stems are used for charcoal, gunpowder, fences, basket work, and fuel. It is now also employed in the manufacture of cheap carpets, bags, sacks, and, mixed with cotton, forms cheap broadcloths. It is even mixed with silk, and from its lustre can scarcely be detected. No article is so universally diffused over the world as the Indian gunny-bag. It is sent from Calcutta to Penang, Singapore, Sumatra, Java, and the whole of the Indian Archipelago for packing pepper, coffee, sugar and vegetables. Jute gives employment to hundreds of thousands in India. Every Hindoo passes his leisure moments, distaff in hand, spinning gunny twist, and in this way an important industry and means of livelihood is placed within the reach of all. It is calculated that the quantity of Jute fibre produced in India is not far short of 500,000 tons annually. Rauwolf says this plant is used about Aleppo by the Jews who boil the leaves to eat with meat, whence it is called Mauve des Juifs.

41. Corchoris acutangulus, L. Another species not uncommon in the East, referred by Centeno to the island.

42. Grewia multiflora, Juss. Bangalad, Visayan; Ke-lakki Sundanese, Malay. A shrub common in the East Indies, and which, under the name of *G. sepiaria* and *G. prunifolia*, is said to extend to the Fiji Islands. It has been seen by me also in North Australia as well as Java, Sumatra, Singapore, and Celebes.

43. Muntinga calabura, L. A fruit tree which belongs to tropical America, and which only within the last 20 years has been introduced into Luzon. It is now spread everywhere, and is seen in every garden about Manila. As it grows freely, gives abundant shade, and has a pleasant green appearance besides producing an agreeable fruit, it is much esteemed. The fibre of the bark, and the wood are both valuable. It would be worth introducing into these colonies.

CELASTRACEÆ.

44. Gymnosporia montana, Wight et Arn. A tall shrub or small tree common in the Indian Peninsula and probably in Africa. I have met with it in Perak and in the Moluccas, and it extends to Australia.

RHAMNACEÆ.

45. Gouania leptostachya, DC. A climbing weed diffused through the East, of no interest except that one species of the same genus produces the "chaw-stick" of Jamaica.

AMPELIDEÆ.

46. Vitis trifolia, Wallich. Alangingi, Alupidan, Visayan; Aroai Landuk, Sundanese (all climbing plants are called Aroai in Sundanese). The whole of the jungles in the East are bound together by various species of vines, all of which produce a fruit of some kind, but none having the smallest pretensions to utility. The species here enumerated is very common in East India and the Archipelago, and has a whole host of synonyms. It extends to Australia.

47. Vitis lanceolaria, Wallich. Burmese, Kyee-Nee-Nway. Common in the tropical forests especially in rocky places. From Tannasserim to the Andaman Islands, through Burmah, Malaysia, the Archipelago to the Philippines.

48. Vitis capriolata, Don.

49. Vitis pedata, Vahl.

50. Leea sambucina, Willd. This is another common tree or shrub, coarse in appearance with conspicuous reddish aspect, very common about Perak. It extends to Australia.

SAPINDACEÆ.

51. Schmidelia cobbe, L. An unimportant shrub distributed through tropical Asia and the Indian Archipelago, and extending to Australia. The characters of the plant are very variable, so that two or three species and another genus (*Allophylus*) have been made out of the varieties of the one named. The berries are said to be very poisonous, which earned for the tree the name Toxicodendron, yet the root is astringent and employed by the native physicians for diarrhœa.

52. Capura pinnata, Blanco, in Pampanga called Talinouno.

53. Cardiospermum halicacabum, L. This straggling climbing annual with its heart-shaped bladder-like capsule, is common to most tropical regions both east and west, migrating originally from America. It is a peculiar plant, as common about the ruins of Malacca as it is in some scrubs of Queensland.

ANACARDIACEÆ.

54. Anacardium occidentale, L. Casoi, Tagalo; Bunga, Cadju, Malay. This is the Cashew nut which bears a large fleshy receptacle, like a pear, supporting the fruit, which has a husk containing a powerfully acrid oil. The tree is only found in cultivation, having been introduced from the Brazils, where the native name is Acaju. Blume and Miquel state that it is only cultivated in Java, but it is common in the Malay Achipelago and the Philippine Islands. The receptacle when ripe is disagreeably astringent, and produces a painful effect upon the fauces. A use is made of it in the Philippines which I have not seen referred to by other writers. This is to adulterate cocoa and chocolate. In the Cuyos Group I found that the nut was largely used for the purpose, and, as the natives are very poor, and cocoa not always to be obtained, it is used as a substitute. At the Convento de San Agustino in Cuyo

the floor of one of the large rooms had a great heap of these nuts piled up at the time of my visit in the month of April. They had been roasted and dried, and in that state were exactly like earth nuts in taste. The artificial chocolate made from them is not at all unpalatable. It consists usually of equal parts of cocoa-nibs, casoi, and pea-nuts.

55. Semecarpus anacardium, L. The fruits of these trees are, like miniature Cashew nuts, attached to the thick succulent pear-shaped base of the calyx. The species is widely distributed over East India and the Archipelago, extending to Australia. I believe the natives eat the fruit, which is yellow, smooth, and nearly as large as the nut itself.

56. Semecarpus albescens, Kurr, or *S. Philippinensis*, Engl.

57. Spondias dulcis, Forster. Ciruelas, the Tagalo rendering of the Spanish name for plum. The Tahiti apple or hog-plum introduced from the Pacific Islands. It is like a large plum, of the color of an apple, containing a stone covered with long hooked bristles. The flavour is said to be like that of the pine-apple. It is has only lately come into cultivation in the Philippines.

58. Mangifera indica, L. Manga in the Philippines generally and also in Malay; in Javanese Ambe. A native of the south of Asia or the Malay Archipelago. It has a number of ancient common names, and a Sanscrit name which is Amra; Ambe in Ceylon, whence the Persian and Arab Amb. It is now cultivated in all tropical countries. Different authors give very diverse opinions as to where the best mangoes are produced. I can only record what has been my experience, since, in matters of taste, opinions are so divergent. I have never seen any fruit surpassing the mangoes of the Philippines and of Java. Large numbers are annually exported from Manila to Hong Kong. There is a small fragrant kind grown in China called Mung-ko, but Mang-ko is the Mandarine word for the fruit, and Mong-kwo in Punti. The mangoes in the Malay Peninsula are generally of the poorest description.

MORINGACEÆ.

59. Moringa pterygosperma, Gaertn. Marungay and Calungay, Tagalo; Kelor, Malay. This is the well-known horse-radish tree; cultivated throughout the East, including the Philippine Islands. The flowers, foliage and fruit are eaten by the natives, and the rasped root employed as a substitute for horse-radish. From the seeds is expressed the oil of Ben so highly esteemed by watchmakers, and not becoming rancid by age. It is perfectly insipid and inodorous, and used for extracting the fragrancy of jasmine, orange, *Acacia farnesiana*, &c. The cultivation of this tree dates from considerable antiquity, and its medicinal virtues are equally esteemed by all the Malay races. Rumphius and Horsfield have celebrated its virtues, the former more than two centuries ago. From it was derived the *lignum nephriticum*, a drug much used in renal diseases. The ripe seeds and the unripe seeds known in Europe as Nux Behan, are also sold as a drug. The leaves are used as a vescicatory; in short the list of the virtues of this tree is a long one. The Tagalo name Calungay is applied to three different trees, the above, the *Antiaris* or Upas, and the tree which is said to show signs of feeling when wounded by shrinking, groaning, &c.

LEGUMINOSÆ.

60. Crotallaria linifolia, L. Gering-Geringan, Malay. This is a large genus numbering between 100 and 200 species dispersed over the warmer regions of the whole world, producing one of the sunn-hemps of commerce, which rivals the jute almost in usefulness. Crotallarias or "rattles" of several kinds are amongst the commonest weeds in the East and Philippines.

61. Crotallaria quinquefolia, L.

62. Crotallaria linifolia, L.

63. Indigofera tinctoria, L. Anil, Tagalo; Tarum-kembang, also Nila, Malay; Sanscrit, Nili; Chinese (Punti) Tin, Mandarine Tien; Japanese Koma-Isunagi. Our own name Indigo is

from the Latin Indicum, which denoted the country from which the Romans obtained it. Roxburgh says, "Native place unknown, for though it is now common in a wild state in most of the provinces of India, it is seldom found far from the districts where it is now cultivated or has been cultivated formerly. The indigo of the Philippines is generally highly esteemed as of a superior quality. The dye is derived from three species which are grown very profitably in the provinces of Pampanga, Bataan, Laguna, Tayabas and Camarines."

64. INDIGOFERA GALEGOIDES, DC.

65. GLIRICIDIA MACULATA, B. & H. Maricacao, which name is a corruption of the Spanish Madre de Cacao. This is an American plant which has been introduced into the Philippines as a kind of protection for the young cocoa trees, whence it is called "Mother of Cocoa." I have never been able to ascertain what particular benefit was supposed to be imparted to the young cocoa by its proximity, but certain it is that they are never seen apart in the gardens or in the fields, and the natives do not seem ever to plant one without the other. The plant has showy lilac flowers like Wistaria, and its clustered blossoms are seen in all the native gardens around Manila, and indeed through all the islands.

66. SESBANIA ÆGYPTIACA, Pers. Jaijanti, Malay. This genus is widely spread over the tropical regions of New and Old World, and the species named is a common weed in tropical Asia and Africa, and, as well as the following, extends to Australia.

67. SESBANIA ACULEATA, Pers.

68. ZORNIA DIPHYLLA, Pers. This species, which is common in the tropics of the whole world, is so abundant on the slopes of the crater, that it almost takes the place of grass. It is quite an insignificant little weed.

69. DESMODIUM GANGETICUM, DC. Docot-docot, Tagalo; Kajang gunong, Malay. These pretty little weeds are widely diffused over the tropical regions of both worlds. The three species mentioned here are spread over the East Indies and the Archipelago, and two of them I have met with in South China and Japan.

70. Desmodium pulchellum, Bentham. A weed or undershrub spread over India from Ceylon and the Peninsula to the Archipelago, and northwards to the Himalayas, South China, the Philippines and Australia.

71. Desmodium polycarpum, DC. A range like the last species, but extending to the Pacific islands as well as Australia.

72. Desmodium parvifolium, DC. Common in the hilly districts of India, from Ceylon and the Peninsula to the Archipelago, and northwards to the Himalayas, the Philippines, South China to Amoi and Japan, where it is called Hime-no-hagi, and *D. podocarpum* Nasubito hagi, or the thief-pea.

73. Desmodium latifolium, DC. This species I have not seen.

74. Mucuna gigantea, DC. Aroai-gurahit Sundanese; in Japanese Hashio-mami, meaning a peculiar kind of bean. A plant well known by the irritating hairs on the pod. They are not barbed, but minute needles, sharp at both ends and twisted in shape, so that any friction rubs them into the skin. It is a rather pretty, climbing plant, with greenish-yellow flowers on pendulous peduncles. Widely distributed over East India and the Archipelago, the Philippines, and the islands of the South Pacific. There are two species in Hong Kong, but quite different from this, and not known from elsewhere. A decoction of the roots of *M. gigantea* is said to be a powerful diuretic. The hairs are esteemed as an anthelmintic; the ripe pods are dipped in syrup and scraped. When the syrup is as thick as honey from the hairs, it is fit for use. It acts mechanically, causes no uneasiness, and may be safely taken from a teaspoonful to a tablespoonful, fasting. The worms appear with the second or third dose. A vinous infusion of the pods is said to be a cure for dropsy. An infusion of the roots with honey is used in India by native physicians for cholera morbus (Don).

75. Mucuna atro-purpurea, DC.

76. Canavalia obtusifolia, DC. Kranjang, Javanese. In Malay the same word is applied to the lemon tree. This species is common on the sea-coasts of South America, Africa, and tropical

Asia. It is found also in Australia from New South Wales to Western Australia, in fact everywhere except on the south coast.

77. Canavalia ensiformis, DC. The leaves, pods and unripe fruits are cooked and eaten with rice, but some of the species are very poisonous.

78. Phaseolus vulgaris, L. Kajang-bungi, Leu-tiek, Sundanese; Tau, Punti; Tsam, Mandarine; Japanese, Injen mame, but there are many other names. Several species of this genus have been long cultivated in various countries as beans or kidney-beans, amongst which the above species or common haricot is included. There is much controversy as to the original home of *P. vulgaris*. The whole question can be seen at length in De Candolle's "Origin of Cultivated Plants." Without entering into the matter I may summarize the result of the discussion which is according to DC.:—1. *P. vulgaris* has only been cultivated in India, the south-west of Asia, and Egypt in comparatively modern times. 2. There is no proof that it was known in Europe before the discovery of America. 3. The genus is South American for the most part. 4. Probable specimens have been discovered in ancient Peruvian tombs, while none such exist in the ancient tombs of Egypt, Greece or Rome. There are many cultivated species, three of which extend to Australia, where, like rice and some other domestic plants, they may have been introduced by the Malays, who have visited the north coast annually for trepang fishing for more than a century.

79. Phaseolus trinervius, Heyne.

80. Phaseolus calcaratus, Roxburgh.

81. Pachyrhizus angulatus, Rich. (herb. DC. prod.), Bang-kuang, Malay. Cultivated in India, China and Mauritius for the sake of the root, a single, turnip-shaped tuber. It is eaten both raw and cooked, but is not valued much. It is said that the roots are sometimes as thick as a man's thigh, and six or eight feet in length.

82. Flemingia strobilifera, R. Br. Hahap-paan, Sundanese. This plant is a familiar object in all the jungles of the East,

while in China, especially about the peninsula opposite Hong Kong, it constitutes a very large portion of the shrubby vegetation in all waste places. It is remarkable for its large brownish bracts, which look like dried hops, and enclose pretty white flowers.

83. Clitoria ternatea, L. This climber with its pure blue flowers, though once confined to Ternate, is found in all the jungles and in waste places on the coast in China and Japan. In the latter place it is called the Chio bean. In Malay it is called Bunga-biru. The blue colour is extracted as a dye in many places, and Rumphius tells us that it is used for colouring boiled rice in China.

84. Cassia alata, L. Apostola, a native name in the Philippines derived from the Spanish ; also Balayong, Dauan-Kupang, Javanese and Malay. This shrub or small tree is a showy species of the very large genus, and its large leaves and tall spikes of bright yellow flowers are familiar objects in every island of the Archipelago and in the Philippines. In some parts of the Malay Peninsula it forms considerable thickets, but Malacca seems to be its stronghold. The interesting collection of Dutch and Portuguese ruins, surrounded with thousands, nay tens of thousands of Chinese tombs, is almost a thicket of *Cassia alata*. It is a native of Asia according to some authors, and at any rate it was a weed in the time of Rumphius ; but many regard it as no more than a variety of a South American or West Indian species, which is probably correct. It was valued as a drug, and may owe its acclimatisation to this fact.

85. Cassia fistula, L. A tree indigenous to India, cultivated and now naturalised in Egypt, tropical Africa, the West Indies and Brazil, besides the Indian Archipelago and the Philippines. There is scarcely a garden about Manila, and all the principal cities of the East, that is not adorned with its beautiful clusters of yellow or red perfumed blossoms. Many think that the name is due to the long slender cylindrical pods which sometimes measure half a yard or more, but the origin of the term *fistula* is of great antiquity, and dates back to the time when the bark of

this and other species was exported from the East in thin pipe-like peelings, like cinnamon. Hence the Latin word Casiæ rufæ fistularem of Galien, and the Κασιας σύριγξ of Greek writers. Syringa is a name now applied to the lilac, and by some strange perversity commonly applied to the mock orange (*Philadelphus coronarius*). *Cassia fistula* has had a great reputation formerly for the mild laxative qualities of the pulp in which each seed is embedded. The number of authors cited by Hanbury and Flückiger in their treatise on pharmacography, shows how ancient is the use of the drug. See also Vincent "Commerce of the Ancients," Vol. II. 712. The Malay name appears to be Bubini.

86. Cassia tora, L. Native of East Indies, China, Japan and Cochin China.

87. Tamarindus indica, L. This well-known tree hardly needs any special reference, but it may be mentioned that the island of Java owes much of its beauty to the manner in which it has been planted all along the road sides. Thus all the high roads have been converted into cool and shady groves. They are fine trees, and grow straight and stately like pines. I was somewhat surprised to find that the attempt to make similar groves of the roads round Singapore and Penang had partially failed. The few trees that remained had not done well. This was owing to the poorness of the soil in the Malayan regions. The immense richness of the alluvial and volcanic plains of Java can alone produce the stately tamarind trees of that island, which are probably unequalled in the world, reminding one of the gigantic Cryptomeria grove lining 20 miles of the road to the Shogun's temple of Nikko in Japan. The Visayan Indians call the tamarind Camalaguy; the Malays Assam-kirangi; the Burmese, Magi-pen. The wood of the tree is usually fibrous, loose-grained and perishable; but in Java, where the trees are well nourished and old, the heart-wood, though small, resembles ebony in hardness, and is dark-coloured with beautiful dark red veins. The tree yields a white resin which is valuable. The Dutch planted *Pterocarpus indicus* on the road sides in Malacca.

88. Acacia farnesiana, Willd. This species is a tree which covers much of the slopes of the volcano, or rather did so cover them at the time of my first visit, for afterwards every vestige of vegetation was burnt away. I was quite astonished at the abundance of this particular kind of plant, and I had never seen anything like it before except in one or two volcanic stony slopes in Java. The tree had a familiar aspect to me also on account of its being not an uncommon bush in tropical Queensland. The species is very common in the tropical countries of the whole world, and is really an ornamental shrub from the curious and large-sized thorns with which it is covered, its pretty orange blossoms, their fragrant perfume so much richer than any other Acacia and different in aroma, and its pretty foliage. It is cultivated on the Genoese coast. To perfumers it is a most valuable assistant, possessing a fragrance which is not found elsewhere. It bears some resemblance to the perfume of violets, but much stronger, and is used to fortify that scent which is naturally weak. The yield of flowers is from one to twenty pounds from each plant. The blossoms are gathered after sunrise. A very strong oil and pomade is obtained by maceration. In Africa, principally in Tunis, an essential oil of Cassie as it is called, is sold at about 80s. per ounce. The French and Italian flowers are not sufficiently powerful for perfumers.

89. Arachis hypogæa, L. Katjang-goreng, Malay; Ti-tau, Chinese; Togin-mame, Nankin-mame (Foreign-bean, Nankin-bean), Japanese. A plant, the original home of which was long controverted, but probably according to De Candolle, American. See the whole argument in "The Origin of Cultivated Plants." Much used in India and China as food, and for the production of an oil as serviceable as olive oil, being clear, limpid, and not turning rancid easily.

90. Albizza procera, Bentham. Widely distributed over India and the Archipelago as far as Australia. Grown for the sake of its gum. Ki-hiang, Sundanese.

91. PITHECOLOBIUM DULCE, Willd. Camanchiles, Visayan, Coroo-koopillay, India. Under the name of *Inga dulcis* this tree has been introduced by the Spaniards from America into the Philippine Islands. All round Manila the sides of the roads are planted with it, and a very poor and straggling tree it becomes under the influence of Manila dust. In Singapore it is used for hedges, and there has quite a different appearance, when washed by the frequent rains of that moist climate. It is cultivated on account of the fleshy sweet pulp which is contained in the twisted red pods. I am not acquainted with the meaning or origin of the word Camanchiles, called also Camansilla. The seeds yield a light-colored oil about the consistence of castor oil. See De Cand. Prod. Vol. 2. p. 436; Roxb. Cor. Tom. I. 99; Willd. Spec. 4, p. 1,000; Sprengel Syst. Veg. 4 in Tom. 3. p. 12; Blanco, Flora de Filipinas, 2nd Edit., Manila, 1845, p. 370. Blanco spells it Camonsiles, identifying the species as *Inga lanceolata*, calling attention to two varieties, one larger with thorns and glabrous pods. He observes that neither corresponds with Sprengel's species, which is pubescent, while these are glabrous with small inconspicuous flowers.

92. LEUCÆNA GLAUCA, Benth. Agho, Visayan. This species has become widely diffused through the tropical regions of both worlds, and has become a wild flower in several parts of Asia and Africa. It is thoroughly domesticated in the Philippines; every garden is adorned with its bluish-green pinnate leaves studded with pale yellow or white globular heads of flowers. It also frequently forms thickets along the roadsides in Luzon and Panay. The unripe seeds and leaves are eaten raw with rice in salad, and the ripe seeds are eaten roasted. The Malays call it Kamalang-diengan.

93. ENTADA SCANDENS, Benth. Gohong-bacay and Balonos, Visayan dialect; Go-go Tagalo; Aroai-garut-penjang, Sundanese. This large climber is known in Australia as the Queensland bean. Its large seeds are made into match-boxes and other ornaments. It is very common in all the jungles of the East, and the large

seed-pods are conspicuous objects. The seeds are roasted and eaten in Java.

94. Mimosa pudica, L. Aroai-reba-bangon, Sundanese. The common sensitive plant has become a terrible weed through the islands of the Indian Archipelago. No one would credit the extent to which it covers the ground, forming tangled thickets of a useless and annoying character throughout the Malay Archipelago. It has only begun to appear in the Philippines.

95. Bauhinia, sp. (?). Amongst my collections there are some Bauhinia leaves from the volcanic island. The genus has two or three common representatives in the jungles of the island.

COMBRETACEÆ.

96. Terminalia catappa, L. Talisai, Tagalo and Visayan; Nattoo-Vadom, Hindostani; Catappa, Malay; Adappo, Alfura (dialect of Minahassa, Moluccas); Sanscrit, Ingudi, called by the Spaniards the almond tree, and has been cultivated. The fruit is a nut scarcely two inches long, flattened oval, with a flange all round it. The kernel bears but a small proportion to the shell and green outer covering. Exceedingly difficult to break, and tasteless. It yields an excellent oil, thicker and more amber-coloured than almond oil. Don says that the bark and leaves yield a black pigment of which I never heard, but I think he is incorrect in saying that Indian ink is made from this dye. The leaves are large, and give a fine shade. It is much used as a shade tree in the parks and roadsides in Singapore, Philippines, &c.

97. Lumnitzera racemosa, Willd. Culasi, Tagalo; Duduk, Sundanese. A coast tree, the scarlet flowers of which adorn the mangrove scrubs occasionally in all the islands. According to Bentham it extends to East Africa and the Pacific. There are only two species in the genus, the white and the red-flowered. Both were forwarded to me from Taal, but I suspect they came from the mainland and nearer to the sea. The same may be said of *Terminalia catappa*, from the abundance of which the town of Talisay derives its name.

98. Quisqualis indica, L. Niog-niogan, Tagalo; Kaju-bulan or round wood, Malay. This showy red and pink climber with its profusion of flowers is said to be a native of India, but it appears to be far more at home in the Philippine Islands, where its handsome blossoms may be seen on all the roadsides about Luzon. It grows much in the same way about Burmah, where it goes by the name of Da-wai-hmine. *Q. loureiri*, a native of Cochin China, with white and red flowers is used as a vermifuge, and so is *Q. chinensis* which grows about Macao. In the Punti dialect of Chinese, Kap-kwan-tsz; Mandarine, Kiah-kiun-tsz. In Japanese it is called Shikunshi.

MYRTACEÆ.

99. Psidium guava, L. See *antea* remarks on the species in the account of the fossil leaves of Taal (p. 723).

100. Eugenia sp. (?) Lumboi, Tagalo; Macupa Visayan. Whilst at Cuyos group west of the Philippines, I found that the natives subsisted to some extent on the fruits of a Eugenia, which grew very commonly in the jungles of the interior of the island. It was about the size of an olive, and of a deep purple colour when ripe. The resident monks informed me that when the monsoon was very severe so that they could not get out on the reefs to fish, and the rains changed the whole of the lower lands into a marsh so as to stop all agriculture, the poorer natives had to abandon their homes and take to the mountains. During this time they had to subsist principally upon lumboi and roots. This food is of a very indifferent kind, and I was assured that there never was a year in which several of the natives did not die of starvation. The species is probably *Eugenia jambolana*, Lamarck. The Anglo-Indian name for the rose-apple, Jambosa, is said to be derived from the Malay word Shambu. I do not know the word for this species. It is called Kepa in Amboyna, in Java, Salam, which is the Malay name for one species. In Sundanese a species is called Ki-sierum-lumbut. Jambu-blimbing is a common Malay name for one species, and Jambu generally for all the Jambosas. The species here referred to extends to Australia, as far south as the Tweed River in New South Wales.

101. Barringtonia acutangula, Gærtn. Boton and Potat in the Philippine dialects; Bangung, Javanese; Puja, Celebes; Balung-bung, Sundanese; Kaju-kendoon, Sundanese and Javanese; Buton-laut, Malay. These splendid trees, with large showy foliage, are seen on all the strands of the Indian Archipelago, and extend to Australia. The large quadrangular fruits strew the beach all along the north-east coast of Australia. It is hardly common in the Philippines. It is said that the seed mixed with bait stupefies the fish like *Cocculus indicus*. The flowers form a ring of crimson stamens, long and drooping, but falling off on the merest touch, in fact even by the heat of the sun, so that after morning the ground near them is strewn with the fallen blossoms.

102. Melaleuca leucadendron, L. Kaju (wood) puti (white). This species, which is the one from which the Cajeput oil is produced, is very widely and abundantly diffused in the Indian Archipelago and Malayan Peninsula, but is equally widely distributed in Australia down as far as Sydney. The oil is one of the principal articles of trade in Amboyna, but the best kind comes from Buru, the island separated from Amboyna by only a narrow strait. A Dutchman who carried on the trade at Amboyna, told me that his operations were confined to the south side of the island. The natives belonged to the tribe of Alfurus, and it was very difficult to get them to approach the coast, as they were excessively timid. My informant said that he always had to order the oil that he wanted beforehand, which the Alfurus used to say would be ready in one moon or two, as the case might be, and on returning he would find the people at the place appointed. The oil is obtained by boiling the leaves with water in an iron vessel closed by a wooden lid. A long bamboo tube conducts the steam into a covered cooler, where it is condensed, and the oil subsequently skimmed off. It is perfectly transparent and as limpid as water. The smell is aromatic and agreeable to some. The samples obtained by me were quite different from that usually sold under that name by chemists. It is more limpid, has a deeper and more decided green colour, and

a more powerful odour. The difference may arise from keeping it, but doubtless it is much adulterated. This tree is commonly called the tea-tree in Australia, and by a strange perversity some few persons have taken to spelling it Ti-tree, a name which is applied to quite a different plant in the South Sea Islands. Our species is also the paper-bark tree, from the extraordinary tennity of the layers of bark, which are as thin as the finest tissue paper. All the rivers in North Australia are so densely lined with these trees, and these alone, that it forms impenetrable thickets in most places, and this for hundreds of miles into the interior. The river Katherine, in Arnheim's Land, may be recognised at any portion of its course by the blue thickets of this foliage, which may be seen at long distances. I believe that the tree is the most extensively diffused of all known trees in the Eastern Hemisphere.

LYTHRARIEÆ.

103. Lagerstroemia flos reginæ, Retz. One of the handsomest and most showy flower trees of the East, whose tall spikes of lilac or pink flowers form handsome objects in a great many jungles. It is called Bunga, or *the* flower by way of excellence in Malay, but I think it has some other special name. Amongst the Tagalo and Visayan Indians it is called Banaba. The timber is highly esteemed.

104. Punica granatum, L. In Visayan, Bomba and Malingin; Sanscrit Darimba, whence probably, says De Candolle, most of the modern Indian names are derived. The domestic use of the fruit is of great antiquity, as the Hebrew name of Rimmon and the Arabic name Rumman testify. It is twice mentioned in the Odyssey, says DC., under the names of Roia, Roa and Sidai. The leaves and flowers of a pomegranate described by Saporta have been discovered fossil in the pliocene strata of France. The above-cited author states that botanical, historical, and philological data agree in showing that the above-mentioned species is a native of Persia. Its cultivation began in prehistoric times, and it early

extended first towards the west and afterwards into China, where it is called Chek-law. It owes its spread not so much to its popularity as a fruit, as to its ornamental character and medicinal virtues. It is seldom seen on the table, and rarely or never in the markets.

105. Sonneratia acida. L. In Tagalo and Visayan, Pagat-pat, in Sundanese and Javanese Bako, in Malay Bakor, but this applies to a good many mangroves. A species common on all the swamps and salt water marshes throughout the Malay Archipelago. In Western Borneo and the Malay Peninsula it lines the rivers to the exclusion of other trees. The Europeans call it the "Willow tree," which it is not unlike, except that it has a large green apple-like fruit, with the valves of the persistent calyx all round as in popular representations of the sun's flaming rays. It is not uncommon in North Australia.

PASSIFLORACEÆ.

106. Carica papaya, L. In most of the modern Indian languages the fruit which we call papaw, is called papaya, itself a corruption of the Carib ababi (De Candolle). It is supposed that the original habitat of this plant is from the Gulf of Mexico or the West Indies. Although much eaten by the natives it is not highly esteemed by Europeans, nor do I think the fruit ever comes to as much perfection in India as I have seen it attain in Australia. The young fruit boiled is an excellent substitute for vegetable marrow. It is said that the leaves of the tree make meat tender if they are well folded round it. I have seen this tried with success, but I have failed to produce the same effect when I made the experiment myself. The Chinese call it Muk-kwa.

CUCURBITACEÆ.

107. Lagenaria vulgaris, Ser. in DC. Prod. This is the well-known gourd plant which, under the name of Calabash in the West and various appellations elsewhere, is known almost in every

country from the earliest times. It is of Indian origin, and its history and spread have quite a literature of their own for which I must refer readers to De Candolle especially, and Asa Gray in the American Journal of Science, 1883, p. 370. I just wish to call attention to the fact, that the species is stated in most botanical works to be poisonous, but wherever I have been I have found the natives use it as food but with a little preparation to mitigate its nauseous bitterness. In its crude state it is taken as a purgative. There is no country perhaps where the gourds are so largely used for domestic purposes as in Japan. The long gourd constricted in the middle is the conventional Saki bottle, which the traveller fastens at his waist at the constriction in the middle. Bottles of every size and pattern can be obtained, from those holding only a gill to gourds holding a gallon, a specimen of which I have in my possession. Almost any pattern can be procured. The species grows wild in North Australia where it may have been introduced, but this is only conjecture.

108. Luffa acutangula, Willd. Malay, Lobat manis, or Petola; Hindoo Jhinga, Torooee; Sundanese, Jingi; Javanese Aroi-kaju-rajam. A much valued vegetable throughout the Archipelago, and is offered largely for sale in all the markets. It is sweet like young peas, and very delicate to some tastes, though Don says it is insipid.

109. Momordica balsamina, L. Papare-utan, or jungle cucumber, Malay. This species is widely spread over Asia, Africa, America and Australia. It is a climbing plant with long, fusiform fruits of bright yellow, which, bursting, disclose the seeds enveloped in a brilliantly red pulp. This plant is famous in Syria for curing wounds. Slices of unripe fruit are infused in oil and exposed to the sun until the oil becomes red. It is applied to fresh wounds on cotton.

110. Momordica cochinchinensis, Spreng. Both these species are cultivated but for ornament. In the Philippines the general name for all the family of melons and pumpkins is some form of the Spanish *pepino*. Most of the principal varieties of pumpkins,

such as the Yellow Gourd, the Spanish Gourd, the Turban Gourd, Trumpeter, Squash, &c., are grown in the Philippines. The origin of this plant is still doubtful, and it has been the subject of much learned discussion, for which readers can consult De Candolle, Asa Gray, &c. The vegetable forms a large ingredient in the food of the Malayan and Chinese races.

111. Melothria indica, Loureiro. The so-called common wild bryony of the Indian Archipelago is pretty widely diffused in the Philippines.

RUBIACEÆ.

112. Sarcocephalus nudulatus, Miq. Tagalo, Bancal; Sundanese, Kappel. This genus produces some fine timber trees.

113. Sarcocephalus subditus, Miq.

114. Sarcocephalus glaberrimus, Miq.

115. Wendlandia paniculata, DC. Another timber tree with no special character giving it importance.

116. Dentella repens, Forst. This insignificent weed with minute leaves and flowers, is spread all over the East, and is found right through the continent of Australia from north to south. I may say that I have noticed it everywhere in my travels. At Amboyna the natives attributed some medicinal virtues to the leaves.

117. Hedyotis paniculata, L. Mamaniran, Malay and Sundanese. Another wide-spread weed exceedingly common in the East, but not extending to Australia.

118. Mussænda frondosa, L. Cahoi-dalaga, Tagalo; Marua, Malay; Pat-ip-cha, Chinese; Japanese, Konronka. This shrub is widely diffused through tropical regions, and it has a peculiarity which forces it into notice. One of the outer flowers of each corymb is produced into a large bract-like white leaf, which makes the plant at a distance look as if scattered over with large white flowers. The flowers themselves are small and inconspicuous,

with a golden yellow corolla-tube. Common everywhere in the East extending to South China, and I have certainly seen it in Japan, near Simonosaki, or a closely allied species, probably *M. parviflora*.

119. Morinda citrifolia, L. Tumbong-aso, Tagalo; Baja, Malays of Celebes, Nyaw-kyee, Burmese. Widely distributed in the East, and common in Australia within the tropics. It produces a poor fruit which has been mistaken for the "Leichhardt Tree" which is *Sarcocephalus cordatus*. *M. citrifolia* is only found close to the sea-side growing sometimes actually in salt water, which is a useful quality in some situations. The wood is deep brownish yellow, close-grained, light and very tough, altogether a valuable timber though small. The Indians use the root to obtain a yellow and red dye, very permanent when fixed with alum.

120. Pædaria fœtida, L. Cantotai, Tagalo; Daun-kuntut, Malay; Kai-shi-tang, Chinese; Hekuso Kadzura, Japanese, also Yaito Bana. The second Japanese name has reference to the medicinal use which is as a moxa or substance used in surgery to produce a sore by means of slow combustion. This remedy is universally applied in China and Japan on different parts of the body according to the ailment. Thus one spot on each temple for a headache, five on the chest for a cold, seven between the shoulders along the spine for liver complaint and so forth. One meets daily instances of this kind of disfigurement. The weed is a common twiner in all the underwood of the middle island in Japan, and in Luzon, Philippines. Its fetid odor is a constant annoyance to botanists. The fibre is most valuable, and as fine as silk, though not in use.

121. Pædaria tomentosa, Blume. Not nearly so common as the last species, nor extending to Japan.

122. Spermacoce hispida, L. Bubu-lutang, Sundanese. This and the following species are insignificant tropical weeds, and amongst the commonest. They are small annuals which mingle

with the grass, sharing with insignificant Compositæ such an abundant growth that they cease to be noticed. They are as frequent and widely-spread in Africa as in Asia.

123. Spermacoce stricta, L.

124. Spermacoce scaberrima, Blume. Both these species equally common and diffused.

COMPOSITÆ.

All the members of this order on the Volcano of Taal are small unimportant weeds, and this is the case throughout the Philippines. The order has but few representatives in the islands, and hese are unimportant.

125. Vernonia cinerea, Less. This common little weed, with small purple flowers like a small sow-thistle, is well represented in Australia as far south as Twofold Bay.

126. Ageratum conyzoides, L. A common weed over all the warmer regions of the globe, for which we have to thank its introduction as a garden flower. It is a rather pretty species, with pale blue flower-heads, but has become a fearful weed in many places. In Queensland it has spread like the thistle, driving out useful fodder, while no animal will eat it.

127. Blumea lacera, DC. Certainly one of the commonest weeds in the tropics of Asia and Africa, extending into China. None of the species are either useful or ornamental, but they all have a powerful odor which is aromatic in some cases. The flower-heads are seldom above three lines long, in loose spreading panicles.

128. Blumea manilensis, DC.

129. Blumea laciniata, DC.

130. Blumea balsamifera, DC.

131. Sphæranthus indicus, L.

132. Eclipta alba, Hassk.

133. Spilanthes acmella, L.

134. Bidens pilosa, L.

135. Emilia sonchifolia, DC.

To all the above the same remarks which have been made on the first few are applicable. *Spilanthes acmella* is used as a salad. Mr. A. A. Black in the "Treasury of Botany," says, that in Japan it is called Hoko So. I found that near Nagasaki, Oranda Sennichi was the Japanese term which has reference to the Dutch using it as a salad. It is also called Sennichi-kiku or daisy-salad.

APOCYNACEÆ.

136. Alstonia scholaris, R. Br. Dirita, Tagalo, also Batino; Gabus, Malay; Let-topi, Burmese. A smooth evergreen tree called the Devil Tree or Palimara about Bombay. Its tall stems with regular whorls of leaves make it a showy member of the jungle. Like our Australian *Alstonia* its milky sap is a very bitter tonic, though it is little used. The wood is white, light and close-grained, but perishable. It is principally used by the Indians and Burmese to make sword scabbards.

137. Alstonia macrophylla, Wall.

138. Orchipæda fœtida, Blume. A tree with opposite oblong smooth leaves, not common but found throughout the Archipelago among bushes on the mountains. The Malays call it Bunga, also Pohun-Badah or the rhinoceros tree from its having a fetid smell like that of a rhinoceros.

139. Tabernæmontana sphærocarpa, Blume. Pandacaqui, Tagalo and Visayan; Jawie-jawie (?) Malay. Six or seven species of this genus are known in the Philippines, and there are probably many more. In individuals no country is more abundantly supplied. *Tabernæmontana* meets one everywhere; on the road sides, in waste places, and on the edges of jungles. I have mentioned already how the slopes of the volcano are abundantly clothed with small trees of *Acacia farnesiana*. In the same locality *Tabernæmontana sphærocarpa* is quite as abundant. The

obliquely oblong or nearly globular orange fruits frequently united at the base in pairs are well-known and somewhat pretty objects, which meet one on every side. A small species (*T. orientalis*) has become a common and abundant weed about Cairns in Queensland. As far as I have seen I should say that the Philippine Group is emphatically the home of *Tabernæmontana.*

140. Tabernæmontana pandacaqui, Poiret.

141. Holarhena macrocarpa, Hassk. A small genus of insignificant trees and shrubs which are not unfrequent in the dry open forests of the tropics of Asia. *H. antidysenterica* is much esteemed for the medicinal qualities which the name implies. It produces the Connessi Bark of the Materia Medica, valued as a tonic and febrifuge.

142. Wrightia tomentosa, Roem. et Sch. Lanete, Tagalo; Bien-taus, Sundanese. Dispersed over tropical Asia, and probably found in Australia under the name of *W. pubescens.* Mr. Bentham says that a specimen in Cuming's collection from the Philippine Islands appears to be the same.

143. Ichnocarpus frutescens, R. Brown. This is one of a small genus of climbing shrubs, dispersed over tropical Asia, and extending into Africa and Australia. It is very common in the Philippines in the leaf-shedding forests and in the Savannahs. It is equally common in the Malay Peninsula and Burmah. None of the species have any importance.

144. Ichnocarpus ovatifolius, DC.

145. Ichnocarpus velutinus, Miq.

ASCLEPIADACEÆ.

146. Streptocaulon banmii, Decaisne. Another unimportant genus of small twining shrubs found in the open forests of tropical Asia.

147. Calotropis gigantea, R. Brown. Capal-capal, Tagalo; Badurie, Malay. A showy shrub with large leaves and handsome

flowers. Very common in Java, but in all the cultivated lands of India and the Archipelago, including Burmah. It is especially common in fields that are lying fallow, but it is also cultivated for medicinal purposes. It yields the Mudar root *(Radix mudaris giganteæ)*, to which many medicinal qualities have been attributed, the sum of which seems to be this, that the root contains about 11 per cent. of an extracted bitter principle called Mudarine, which excites vomiting, and hence it has been used as a substitute for ipecacuanha. Mudarine has the extraordinary property of gelatinising when heated, and returning to the fluid state when cool. The fibre of the stem is valued, and the down of the seeds is usefully mingled with cotton in spinning. The plant is highly esteemed throughout all the various nationalities of the East.

148. Asclepias curassavica, L. A quite recently introduced plant from S. America, which is as common in Australia as it is in India. It extends through South China to Japan, where it is called To-wata, or cotton.

149. Gymnema syringifolium, Benth. and Hook. A twiner; the genus has a wide range in tropical Asia, though this species I never collected except on the volcano of Taal.

150. Tylophora tenuis, Blume. Batuk-manuk, Sundanese. The genus is like the last in its characters, and is noted for possessing the Ceylon Binooga or *T. asthmatica*, the roots of which seem to have all the qualities of ipecacuanha besides being good for asthma. I have collected this species in Perak, Java and the Philippines, generally on the edges of jungles in the plains.

151. Dischidia nummularia, R. Brown. Duduitan, Sundanese; Daun-ringit, Malay. This interesting little plant is parasitic on the trunks of large trees, and having small disc-like fleshy leaves, in pairs, has a very ornamental appearance as it hangs in festoons from branches in the jungle. Common everywhere in the Archipelago and extending to Australia.

152. Hoya cumingiana, Decaisne. A species of the well-known wax plant. My dried specimens are very imperfect, and I am not at all sure of the species.

LOGANIACEÆ.

153. Buddleia neemda, Hamilton in Roxburgh. Talic-nono, Tagalo; Ki-hiriesan and Sembung-lanang, Sundanese and Malay. A shrub common throughout the Archipelago; the specific name is an alteration of the vernacular name Nimda in Chittagong. This or a closely allied species (*B. asiatica*, Lour. ?) is called Kyoung-mee-koo in Burmah, where it is common everywhere in deserted clearings, savannah forests and along river banks.

BORAGINACEÆ.

154. Cordia myxa, L. Amnonang also Banalo, Tagalo; Aipaka, Amboyna; the Malays generally Baru-laut. This species is dispersed over tropical Asia from Ceylon to the Philippines, and extends into Australia as far as the limits of the colony of Queensland. The pulp is extremely tenacious, and is used for bird-lime as well as for a pectoral medicine, which in India is called Sebestens. Mr. Carruthers states that it is reckoned one of the best kinds for kindling fire by friction, and said to be the wood (which is very soft) used by the Egyptians for mummy cases. It is cultivated in Africa.

155. Cordia subcordata, Lamarck, DC. Prod. This species is also on the Mozambique coast and Comoro Island, and in the Indian Archipelago extending to the Philippines, Australia and Pacific Islands. In India, perhaps only where cultivated (Bentham). It occurs on most of the islets of the Barrier Reef.

156. Ehretia buxifolia, Roxb. Manguit, Tagalo; Kosini, Javanese. This is a tree which is probably restricted to the Philippines, though the genus is widely distributed over the Archipelago.

157. Tournefortia sarmentosa, Lamarck, Illustr. (Vide Benth. Fl. Austral. IV. 390). Pimentia, Tagalo. This species is also found in Mauritius, Timor and the Indian Archipelago.

I have generally seen it in the marshy vegetation at the mouths of the rivers. The flowers were always yellow or white. According to Thozet, the flowers are blue. Other collectors describe them as whitish or pure white. The Philippine specimens referred to by De Candolle are rather more hairy (Bentham).

158. Heliotropium indicum, L. A very common south Asiatic weed which I have met with all through the Archipelago, but which has not as yet extended to Australia.

CONVOLVULACEÆ.

159. Ipomœa bona-nox, L. A large twining convolvulus with cordate leaves on a smooth stalk two or three inches long, with large white salver-shaped flowers nearly five inches in diameter. Common in the jungle and amongst shrubberies, along river-sides all over India, Burmah, the Malay Archipelago and the Philippines. I have heard one species called Ampas-ampas.

160. Ipomœa quamoclit, L. This pretty little carmine-flowered climber has been cultivated for ornament, but is now established as a weed in the new and old worlds. It is believed to be of Indian origin.

161. Ipomœa reptans, Poir. A prostrate floating species found in wet, sandy places, or floating in water, in many parts of tropical Asia and Africa. Corolla pink, purple or white, about an inch and a half long.

162. Ipomœa pes-capræ, Roth. On every strand in the tropics, in Australia as far as New South Wales, and in every warm climate of the new and old world. The leaves are on long stalks and the flowers are purple. In Celebes it is called Batata-pantei. The natives in every country where it grows have great faith in the leaves employed as a poultice in rheumatic affections.

163. Ipomœa batatas, L. Malay, Ubi, which is also applied to the common potato; Keledek is the common Malay name for the sweet potato. The origin of this plant, universally cultivated

in the tropics, is extremely doubtful. The whole question can be seen in De Candolle, loc. cit. He gives the name in China as Chu ; in Punti I find the name is Fan-shu ; in Japanese it is called Satsuma-imo and Riukiu-imo. Common potatoes are called Jagatara-imo, Imo being an edible root. It is one of the most important articles of diet in Japan—a small red variety.

164. Ipomœa pes-tigridis, L. A species with the leaves palmately five-lobed and peduncled, with many funnel-shaped purplish flowers. Common in the East Indies, Archipelago and Philippines.

165. Ipomœa sepiara, Kœnig, MS., Wall. Fl. Ind. A very common species in India, the Archipelago, and China, with oblong cordate leaves and clusters of large flowers of a beautiful rose colour.

166. Lepistemon reniformis, Hasselquist. A climbing perennial herbaceous member of the convolvulus order of no particular interest.

SOLANACEÆ.

167. Solanum nigrum, L. Waste places all over the world ; it being a weed which follows the footsteps of civilised man. The berries though thought to be poisonous are edible, and in the Philippines the leaves are used as a pot-herb.

168. Solanum verbascifolium, Aiton ; Dunal in DC. Prod. This tall and somewhat showy shrub is found on the river banks of all warm countries. The natives in Java roast and eat the berries. In some places in South Queensland it forms dense thickets.

169. Solanum melongena, L. Foki-foki, Ternate and Celebes. The egg-plant Aubergines or Brinjals, the latter an Indian name ; Chinese, Wong-ke-fa ; Japanese, Nasubi ; Malay, Terong. When one sees the extent to which this useful vegetable is eaten in Asia, it must be a matter of regret that it is so little known and cultivated among western nations. In the Malay peninsula,

where vegetables are so few, it is a valuable addition to the culinary resources. In Japan no vegetable is of such service. From June to September inclusive, it crowds the markets and shops, and is seen on every table, and with the Japanese modes of cooking it is certainly very palatable. There are many varieties differing mostly in shape, for the deep purple colour prevails in all. They are shaped like bananas or like pears, but the large variety in Japan is balloon-shaped, three and four inches long, and as much in diameter. The thin white margin round the fruit at its junction with the calyx makes it exceedingly pretty. The species thrives well in Australia, as I know from experience, and at present we have no vegetable to compare with it ; yet it is not used.

170. Solanum tuberosum, L. Ubi, Malay ; Patata amongst the natives in the Philippines; Chinese, Shu ; Japanese, Jagatara-imo. Potatoes of excellent quality are grown in the volcanic soils of the Philippines. The introduction of this plant into the islands is difficult to trace ; I made many enquiries but could find no trace in the Spanish literature. The history of the potato has been made the subject of especial study by De Candolle, and perhaps I may be allowed to insert here a summary of his conclusions :— "(1) That the potato is wild in Chili in a form still seen in our cultivated plants. (2) It is very doubtful whether its natural home extends to Peru and New Granada. (3) Its cultivation was diffused before the discovery of America from Chili to New Granada, (4) It was introduced in the latter half of the 16th century into that part of the United States now known as Virginia and North Carolina. (5) It was imported into Europe between 1580 and 1585, first by the Spaniards and afterwards by the English at the time of Raleigh's Voyages to Virginia."

171. Solanum ferox, L. Karon-dung, Sundanese. A common shrub in India, Java, Borneo, &c., but probably introduced as it is cultivated. A thorny plant with globular berries an inch or more in diameter.

172. Solanum sanctum, L. Another cultivated species introduced from Palestine. Fruit small and globular.

173. Physalis peruviana, L. Potocan, Tagalo; Daun-doba, Malay; Hodzuke, Japanese. The Cape Gooseberry so prized for making preserves in Australia, of which Mr. Bentham says that, though of South American origin, it is perhaps really indigenous in the Pacific Islands, but in the Philippines, as in Australia, it has been introduced.

174. Lycopersicum esculentum, Miller. Sangogiu-nasubi in Japanese, for in all the Indian Archipelago it is called by its Spanish name of tomatte from the American name Tumatle. The Chinese call it Fan-ke, but in all the Asiatic countries its introduction does not date much beyond a couple of centuries back. De Candolle thinks it is of Peruvian origin. Both in the Malay Archipelago and in the Philippines it has become almost naturalized as it is in Australia, and especially in the tropics. In this quasi wild state the fruit loses its large irregular development, and becomes small and spherical like the variety called *L. cerasiforme*, which De Candolle thinks is the same species. This is the manner in which one sees it naturalized in old clearings or near gardens.

175. Capsicum frutescens, Willd. Pasitis (or chilis) in Tagalo; Chabei-besar (large chabei) in Malay, also lada merah (red lada), also lada-china. This species, which is taller and more woody than *C. annuum*, is the one generally cultivated for the manufacture of cayenne pepper. It is a native of South America, but has become naturalized in the east and in Australia.

176. Capsicum annuum, L. Chiles, Tagalo; Lada-china Malay; Pimento in Spanish, and the name Spanisch Pfeffer in German points to its origin in Europe. The word *chilli* would appear to be a Mexican name, and throughout the East generally the small capsicum is known by that name. In China it is called Lat-tsiu; in Japanese Tangiku-mamori.

177. Capsicum minimum, Mill. Stem shrubby, fruit small ovate erect. A shrub, one to two feet high. This species I did not see, but the whole of the capsicums may be regarded as mere escapes from cultivation on the island.

178. Datura alba, Nees. Talamponai, Visayan; Kuchubung-puti, Malay. Very common throughout the East, with large white flowers. It extends to China and Japan, where it is called Chosen-asago. Narcotic virtues are attributed to this plant, and in more than one country it is used to cause intoxication or stupefaction.

179. Nicotiana tabacum, L. Tembakau, Malay; Yen, Chinese. Though the Asiatic people are great lovers of tobacco, none at all approach to the natives of the Philippines in this respect. Men and women smoke unceasingly, and even children begin the habit when quite infants. The Philippine natives surpass all other Asiatics in the cultivation and preparation of the plant. Though the American origin of this plant has been disputed, it is proved almost beyond question. Out of fifty species of the genus *Nicotiana* two only are foreign to America—one a native of Australia, and the other of New Caledonia.

SCROPHULARIACEÆ.

180. Torenia cardiocephala, Benth. Small Mimulus-like shrubs found in shady or damp places with purple, bluish or yellow blossoms. They are elegant wild flowers.

181. Torenia edentula, Griff.

182. Vandellia crustacea, Benth. A small tropical weed widely diffused and extending to Australia; it is a much-branched rambling annual with minute purple flowers. It is found also in Africa and America.

183. Scoparia dulcis, L. Another weedy annual with the same wide diffusion. It is a larger plant, the leaves usually in whorls of three, and the flowers white.

OROBANCHACEÆ.

184. Æginetia indica, Roxb. The small parasitic plants which compose this order are not well represented in the tropics.

This species is widely diffused from India to the Archipelago. It is parasitic on the roots of grasses, with an elongated simple naked scape with one flower, corolla purple, calyx yellow.

BIGNONIACEÆ.

185. Oroxylum indicum, Benth. A small deciduous tree, with large showy purplish flowers, with a yellow tube on short and very thick pedicels. Common in all jungles throughout the East and the Philippines. In Tagalo it is called Pinca-pincahan.

186. Dolichandrone rheedii, Seem. In Tagalo, Tua. An unimportant tree, which is common in the Philippines, and has a habitat amongst the mangroves.

ACANTHACEÆ.

187. Blechum brownei, Tussac. An unimportant herbaceous weed on the coasts.

188. Justicia gendarussa, L. A widely spread evergreen dense shrub, which is spread over the East from India to the Philippines in the tropical forests, but is especially common in the islands of Luzon, along hedges where its small flowers in clusters are never out of sight.

189. Eranthemum bicolor, Schranck. An insignificant tropical weed with rather pretty flowers, similar to one which is common in North-eastern Australia.

VERBENACEÆ.

190. Callicarpa bicolor, Juss. Palis in Tagalo, Katumpang in Sundanese Malay. I did not see this species, but I saw another which is very common all through the East and extends up to Japan, where it is called Ko-Murasaki or Little Purple. It is found also in Australia. This is *Callicarpa longifolia.*

191. Gmelina asiatica, L. All along the coasts and in the swampy forests, from India to the Philippines, its showy racemes of bell-shaped yellow flowers, make it a conspicuous and ornamental object. It is particularly abundant in Perak, about Malacca, and in Singapore. The Visayan Indians call it Bago-bago. The bark and roots of this tree are used medicinally by the natives.

192. Clerodendron infortunata, L. Casopanguil Tagalo. A common evergreen shrub with white flowers in an ample panicle. Common in the tropical and moister forests up to three thousand feet all over the Archipelago and Philippines. The genus is well represented in the jungles throughout the East, producing several species which have highly ornamented red, blue, and white flowers.

LABIATÆ.

193. Ocimum gratissimum, L. This and the following species have no doubt been introduced for their aromatic qualities.

194. Ocimum sanctum, L. Frequently planted round Hindoo temples.

195. Moschosma polystachyum, Benth. A common garden plant kept for its musky odour.

196. Hyptis capitata, Jacq.

197. Hyptis brevipes, Poiteau.

198. Hyptis suaveolens, Poiteau. This has become one of the most terrible weeds throughout the Indian Archipelago. It forms dense thickets to the exclusion of every other kind of vegetation. When withered these thickets are quite impenetrable. In North Australia it is becoming equally troublesome, though introduced only within the last few years. I have seen excellent land in the Malay Peninsula, Java, Borneo, Celebes and the Moluccas quite destroyed by this pest.

199. Anisomeles ovata, R. Br. This is one of the sweet smelling musk plants with all the qualities possessed by the well-known musk plant of North Australia.

200. Leucas aspera, Sprengel.

201. Leucas linifolia, Sprengel. The above two weeds form a portion of all the grassy vegetation of the Malayan region. They are pretty little plants with white flowers decking the green sward more or less all the year round.

NYCTAGINACEÆ.

202. Boerhaavia diffusa, L. A very common weed in the warmer regions of Asia, Africa and Australia. It runs along the ground in rich alluvial soil, with deep rose-red stalks and minute pink flowers. In India an infusion of the roots is looked upon as a remedy for measles.

AMARANTACEÆ.

203. Deeringia celosioides, R. Br. A woody glabrous climber scrambling over bushes to the height of ten or twelve feet. Common in East India, the Archipelago, and extending to Australia and New Caledonia.

204. Amarantus spinosus, L.

205. Amarantus oleraceus L.

206. Amarantus viridis, L.

207. Ærva javanica, Juss.

208. Achyranthes aspera, L.

209. Alternanthera denticulata, R. Br. Nearly all the above are common insignificant roadside weeds in the tropical and sub-tropical regions of the whole world.

CHENOPODIACEÆ.

210. Basella rubra, L.

211. Basella alba, L. These are common garden plants in the East, sometimes grown as pot-herbs, and at other times as ornamental creepers. Their thick fleshy leaves make a good spinach.

ARISTOLOCHIACEÆ.

212. Aristolochia tagalo, Chamisso. A jungle species of this remarkable genus of climbers, which I did not see.

PIPERACEÆ.

213. Piper chaba, Blume.

214. Piper caninum, Adietr. The above are amongst the many native kinds of pepper growing in the East.

215. Peperomia exigua, Miq. One of the many small fleshy creeping plants of the order growing on trunks of trees, but of no importance.

LAURACEÆ.

216. Cassytha filiformis, L. One of the common Indian leafless dodder-laurels, widely spread over tropical Asia, Africa and America, but chiefly near the sea. It extends to Australia, and probably to New Zealand. The genus is, however, chiefly Australian, with the exception of the one species here enumerated. The habit is in every way that of the European *Cuscuta*. It is the wire-like vine which makes so many of the Queensland scrubs quite impenetrable.

EUPHORBIACEÆ.

217. Euphorbia thymifolia, L. A small procumbent Indian weed.

218. Euphorbia pilulifera, L. A common weed which follows cultivation in warm climates all over the world. It has lately come into notice in Australia as a remedy for asthma and diseases of the chest.

219. Bridelia stipularis, Blume. A large scandent shrub with bluish-black berries and tawny leaves, common in all mixed forests, especially those near the sea throughout Malaysia and the Philippines. The Sumatran Malays call it Aka-buah. In the Philippines the leaves are used sometimes as a substitute for tobacco.

220. Phyllanthus niruri, L. There are numerous species of this large genus containing trees, shrubs, and herbs, throughout the East. They are well represented in the Philippines, but as yet there has not been sufficient botanical exploration in the islands to fix the number of species.

221. Phyllanthus llanosii, Müller.

222. Phyllanthus urinaria, L.

223. Phyllanthus simplex, Retz.

224. Phyllanthus reticulatus, Poir.

225. Securinega obovata, Müller. A leaf-shedding large shrub, common in the grassy jungles near water all over the East from India to the Philippines. Genus in omnibus Phyllantho convenit, excepto ovarii rudimento in fl. mas. evoluto. Gen. Plant. Benth. et Hook. III. 276.

226. Breynia cernua, Müller. A glabrous shrub spread over tropical Asia and part of Australia.

227. Antidesma ghæsembylla, Gærtner. This is another widely diffused Asiatic species of shrub or small tree extending to Australia and China.

228. Antidesma bunius, Sprengel. A small evergreen tree; same observations as in the case of the last. In Macassar this is called Buni-kirbau, in Tagalo Binaguyo. The fruits are eaten raw or cooked with fish.

229. Jatropha curcas, L. Tagalo,Tuba; Malay, Balechei-paggar; Thin-baur-kye-ksu, Burmese. An evergreen small tree, universally cultivated as a hedge tree round gardens and villages in Burmah, Malaysia and the Philippines. The capsules are tri-coccous, the size of a large cherry, with large ellipsoid seeds. It is a native of tropical America, now cultivated in all warm countries for its seeds, which yield an oil like castor-oil with violent purgative qualities. It is called *Olium Infernale* in the Dutch shops in Java. It is employed not only medicinally but principally for lamps; in fact, in Java until kerosene came into general use, as it

has now even in the most remote villages, this oil and cocoa-nut oil supplied all purposes of illumination; but it is now almost entirely superseded. It is a beautiful pale yellow color. In India it is called Katamanak. Bhoga bhirinda is an inferior kind of oil from the same source. It has been of late years imported into Britain as a substitute for linseed oil. It answers equally well, and can be obtained from India at a price far below linseed. Quantities of the seed have also been imported into Liverpool from the Cape Verde Islands. It seems to have met with considerable favor wherever it has been tried. The Chinese boil this oil with oxide of iron, and employ it for varnishing boxes.

230. Jatropha manhiot, L. Manihoc or Maniot or Tapioca is not extensively cultivated in the Islands. When travelling in the interior of the Malay Peninsula, one of my principal sources of subsistence was the roots of the maniot boiled like potatoes. They were exceedingly nourishing and palatable, the flavour being something between the sweet and the common potato. Being of large size and cheap, they were a most useful article of food, especially where vegetables are so scarce. The only precaution necessary to get rid of the poisonous juice was to carefully peel and boil them. The maniot is extensively cultivated in the Malacca state, and in Brunei, Borneo, but lately it does not pay.

231. Croton caudatus, Geisel. It is supposed that there are eight or ten species of this interesting genus in the Philippines.

232. Acalypha indica, L. Of this genus there are about ten or a dozen species in the Philippines. They are unimportant, except one or two species with variegated leaves. *A. indica*, an annual Indian weed like a nettle, is said to attract cats like Valerian. A decoction of the leaves is used as a purgative.

233. Mallotus philippinensis, Muell. Arg. A tree with a ferruginous tomentum on the ends of the branches, which is said to be a powerful vermifuge. It is widely spread throughout the East, and very common in North Queensland.

234. Macaranga tanarius, Müll. Arg. A tall, erect shrub, with large orbicular peltate leaves sometimes a foot in diameter. It is found from the East Indies to South China near the coast, and forms a conspicuous portion of all the jungles, especially on their edges. It is very common around Moreton Bay.

235. Ricinus communis, L. Tangan-tangan, Tagalo ; Charak, Malay. As in Australia this showy plant has become an introduced weed. It is, according to De Candolle, probably a native of Abyssinia, Sennar and the Kordofan. It is cultivated in America, and even the ancient Egyptians cultivated it, because the seeds are found in their tombs. The Egyptian name was Kiki retained in modern Greek, while the Arabs call it Kerua. See De Candolle, who says that it is supposed that the Kikajon of the Old Testament, the growth of a single night, was this plant. The English name Castor Oil is from its having been called Agnus Castus in the West Indies.

URTICACEÆ.

236. Trema amboinensis, Blume. Hanarian, Tagalo. A fine tree 40 ft. high, widely spread over East India and the Archipelago, South China, the Philippines and Australia. "It is on the authority of Planchon that I refer this very common Archipelago species to the original *Celtis amboinensis*, Willd. He believes also that this may be the typical *Trema cannabina*, Lour." Benth. Flor. Aust. VI. 159.

237. Streblus asper, Lour. See *antea* p. 723, on the fossil leaves found in the tufa.

238. Malaysia tortuosa, Blanco. A twining shrub with long spikes of most fragrant flowers. The genus appears to be limited to a single species extending over the Indian Archipelago and the islands of the South Pacific to the Philippines. It is called Crow-ash in New South Wales. In North Australia it is very common in water-courses.

239. Ficus hispida, L. Balite, Asis or Isis, Tibig and Hauili in Tagalo; Buah-ara, Malay, and Hambarang, which is

also the Malay name for fig throughout the whole of the Archipelago. This genus (*Ficus*) is certainly one of the most characteristic of the Malay flora, and there is good reason for supposing that there are more than a hundred species in the Philippines alone, and as far as I was able to remark, each island seems to have some pecular species. The genus almost takes the place in the Archipelago that the Eucalypts do in Australia. The timber is, in general, useless. Many species are common to Australia.

240. Ficus hirta, Vahl.

241. Ficus wassa, Roxb. Gohi, Malay. The natives use the bast for tow. The young leaves and fruits are cooked and eaten.

242. Ficus altimeraloo, Roxb. More common in the Moluccas, where it is called Bunga-jangan.

243. Ficus aspera, Forster. Called in Sundanese Aroi-konjal, and this is a name for several other descriptions of *Ficus*.

244. Ficus radiata, Decaisne.

245. Pouzolzia indica, Gaudichaud. A diffuse perennial with the habit of a parietaria or pellitory, with the stems from six to twelve inches long. Common in East India and the Archipelago, and extending to Australia.

246. Pipturus asper, Weddell. Dalonot, Tagalo; in Malay, Ki-buntur. A small tree with a wider diffusion than the last, as it extends to the Pacific Islands and Mascarene Group.

HYDROCHARIDACEÆ.

247. Enhalus koenigii, Rud. A submerged water-plant like the frog-bit of Europe, except that it has linear leaves. This is one of the few salt-water genera, and is found all through the lagoon.

248. Pistia stratiotes, L. In all the fresh-water streams and lakes of the Malay Archipelago, and in the Philippines the surface of the water is covered with small plants which look very like

small floating lettuces of graceful form, and bright green color sometimes tinged with pink. It floats in the water in rafts, the plants being attached together by runners, and deriving their nourishment by roots which hang free in the water. They say that these are sometimes buried in the mud, but I have seen them floating in great rafts quite free and in very deep water. They are abundant in the lagoon, the Indians using them when boiled as a food for pigs. Otherwise the plant is very acrid and probably poisonous. In Java in still ponds where fish are bred, the plant is grown to give them shade, but it increases with such rapidity as to cover the surface and become a troublesome weed. It is called the water soldier.

SCITAMINEÆ.

249. MUSA SAPIENTUM, L. In Tagalo the native Indians call it Platanus or Abaca, the latter name being especially applied to the species from which the fibre known as Manila hemp is obtained. I must be excused for quoting here *in extenso* the somewhat lengthy remarks of De Candolle as to the origin of this species, in order that I may add what little light and experience I have gained in my Australian and Eastern travel. The subject is of unusual interest to us in Australia, as we have undoubtedly three indigenous species in this continent, one of which is not distinguishable from *Musa sapientum*. The following quotation is from "The Origin of Cultivated Plants," p. 304:

"Bananas were generally considered to be natives of Southern Asia, and to have been carried into America by Europeans until Humboldt threw doubts upon their purely Asiatic origin. In his work on New Spain,* he quoted early authors who assert that the banana was cultivated in America before the conquest.

* Humb. Nouvelle Espagne, 1st Ed. II. p. 360.

He admits, on the authority of Oviedo,* its introduction by Father Thomas of Berlangas from the Canaries into San Domingo in 1516, whence it was introduced into other islands and the mainland.† He recognises the absence of any mention of the banana in the accounts of Columbus, Alonzo Negro, Pinzon, Vespuzzi and Cortez. The silence of Hernandez who lived half a century after Oviedo, astonishes him, and appears to him a remarkable carelessness; "for," he says,‡ "it is a constant tradition in Mexico, and on the whole of the mainland, that the *Plantano arton* and the *dominico* were cultivated long before the Spanish conquest." The author who has most carefully noted the different epochs at which American agriculture has been enriched by foreign products, the Peruvian Garcilasso de la Vegas§ says distinctly that at the time of the Incas, maize, quinoa, the potato, and, in the warm and temperate regions, bananas, formed the staple food of the natives. He describes the *Musa* of the valleys in the Andes; he even distinguishes the rarer species with a small fruit and a sweet aromatic flavour, the *dominico* from the common banana or *arton*. Father Acosta|| asserts also, although less positively, that the *Musa* was cultivated by the Americans before the arrival of the Spaniards. Lastly, Humboldt adds from his own observation, "On the banks of the Orinoco, of the Cassiquaire or of the Beni, between the mountains of Esmeralda and

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* Oviedo, Hist. Nat. 1556, p. 112. Oviedo's first work is of 1526. He is the earliest naturalist quoted by Dryander (Bibl. Banks) for America. (The full title of Oviedo's work is "Gonzalo Fernandez de Oviedo y Valdez Sumario dela Natural y General Istoria de las Indias, Toledo 1526. Fol. 52 foll. Another edition is entitled "Primera part de la Historia Natural y General de las Indias, Yslas y tierra firme del Mar Oceano." Sevilla 1535, folio CXCIII. foll., with one plate of very rude wood engravings. Books VII, VIII, IX. and X. refer to botanical subjects. The book was translated from Castilian into French in Paris by Michel de Vascosan in 1555. folio 134 foll. and one plate of wood engravings. There exist only the ten first books of this work. It appears to have been the French translation that De Candolle refers to.)

† I have also seen this passage in the translation of Oviedo by Ramusio, III. p. 115.

‡ Humboldt, Nouvelle Espagne, 2nd. Edit. p. 385.

§ Garcilasso de la Vega, Commentarios Reales, I. p. 282.

|| Acosta, Hist. Nat. de Indias, 1608, p. 250.

the banks of the River Carony, in the midst of the thickest forests, almost everywhere that Indian tribes are found who have had no relations with European settlements, we meet with plantations of manioc and bananas." Humboldt suggests the hypothesis that several species or constant varieties of the banana have been confounded, some of which are indigenous to the new world.

Desvaux studied the specific question, and in a really remarkable work, published in 1814,* he gives it as his opinion that all the bananas cultivated for their fruits are of the same species. In this species he distinguishes forty-four varieties, which he arranges in two groups; the large-fruited bananas (seven to fifteen inches long) and the small-fruited bananas (one to six inches) commonly called fig bananas. R. Brown, in 1818, in his work on the *Plants of the Congo*, p. 51, maintains also that no structural difference in the bananas cultivated in Asia and those in America prevents us from considering them as belonging to the same species. He adopts the name *Musa sapientum*, which appears to me preferable to that of *M. paradisiaca* adopted by Desvaux, because the varieties with small fertile fruit appear to be nearer the condition of the wild *Musæ* found in Asia.

Brown remarks on the question of the origin that all the other species of the genus *Musa* belong to the old world; that no one pretends to have found in America, in a wild state, varieties with fertile fruit, as has happened in Asia; lastly, that Piso and Marcgraf considered that the banana was introduced into Brazil from Congo. In spite of the force of these three arguments, Humboldt, in his second edition of his essay on New Spain (II. p. 397), does not entirely renounce his opinion. He says that the traveller Caldcleugh† found among the Puris the tradition that a small species of banana was cultivated on the borders of the Prato long before they had any communication with the Portuguese. He adds that words which are not borrowed ones are found in American languages to distinguish the fruit of the

* Desvaux, Journ. Bot. IV. p. 5.
† Caldcleugh, Trav. in S. Amer., 1825, I. p. 23.

Musa, for instance *paruru* in Tamanac, &c., *arata* in Maypur. I have also read in Stevenson's travels* that beds of the leaves of the two bananas commonly cultivated in America have been found in the *haucas* or Peruvian tombs anterior to the conquest; but as this traveller also says that he saw beans in these *huacas*, a plant which undoubtedly belongs to the old world—his assertions are not very trustworthy. Boussingault† thought that the *platano arton* at least was of American origin, but he gives no proof. Meyen, who had also been in America, adds no argument to those which were already known,‡ nor does the geographer Ritter,§ who simply reproduces the facts about America given by Humboldt.

On the other hand, the botanists who have more recently visited America have no hesitation as to the Asiatic origin. I may name Seeman for the Isthmus of Panama, Ernst for Venezuela, and Sagot for Guiana.‖ The two first insist on the absence of names for the banana in the languages of Peru and Mexico. Piso knew no Brazilian name. Martius¶ has since indicated, in the Tupi language of Brazil, the names *pacoba* or *bacoba* This same word *bacove* is used, according to Sagot, by the French in Guiana. It is perhaps derived from the name *bala* or *palan* of Malabar, from an introduction by the Portuguese subsequent to Piso's voyage.

The antiquity and wild character of the banana in Asia are incontestable facts. There are several Sancrit names.** The Greeks, Latins, and Arabs, have mentioned it as a remarkable Indian fruit tree. Pliny†† speaks of it distinctly. He says that the Greeks of the expedition of Alexander saw it in India, and he quotes the name *pala* which still persists in Malabar. Sages reposed beneath its shade and ate its fruit. Hence the botanical name *Musa sapientum*. *Musa* is from the Arabic *mouz* or *mauwz*, which we

* Stevenson, Trav. in S. Amer., I. p. 328.
† Boussingault, C. r. Acad. Sc. Paris, May 9th, 1836.
‡ Meyen, *Pflanzen Geog.* 1836, p. 383.
§ Ritter, *Erdk.* IV. p. 870.
‖ Seeman, Bot. of the Herald, p. 213; Ernst, in Seeman's Journ. of Botany, 1867, p. 289; Sagot, Journ. de la Soc. d'hort. de Fr. 1872, p. 226.
¶ Martius, *Eth. Sprachenkunde* Amer. p. 123.
** Roxburgh and Wallich, *Fl. Ind.* II. p. 485; Piddington, *Index.*
†† Pliny, Hist lib. XII. cap. 6.

find as early as the thirteenth century in Ebn Baithar. The specific name *paradisiaca* comes from the hypothesis which made the banana figure in the story of Eve and of Paradise.

It is a curious fact, that the Hebrews and Ancient Egyptians* did not know this Indian plant. It is a sign that it did not exist in India from a very remote epoch, but was first a native of the Malay Archipelago.

There is an immense number of varieties of banana in the south of Asia, both on the islands and on the continent; the cultivation of these varieties dates in India, in China, and in the Archipelago, from an epoch impossible to realise; it even spread formerly into the islands of the Pacific† and to the west coast of Africa,‡ lastly, the varieties bore distinct names in the most separate Asiatic languages, such as Chinese, Sanskrit and Malay. All this indicates great antiquity of culture, consequently a primitive existence in Asia, and a diffusion contemporary with or even anterior to that of the human races.

The banana is said to have been found wild in several places. This is the more worthy of attention since the cultivated varieties seldom produce seed, and are multiplied by division, so that the species can hardly have become naturalized from cultivation by sowing itself. Roxburgh had seen it in the forests of Chittagong§ in the form of *Musa sapientum*. Rumphius‖ describes a wild variety with small fruits in the Philippine Isles. Loureiro¶ probably speaks of the same form by the name *M. seminifera agrestis*, which he contrasts with *M. seminifera domestica*, which is wild in Cochin China. Blanco** also mentions a wild banana in the Philippines, but his description is vague. Finlayson†† found the banana wild in abundance in the little island of Pulo Ubi,

* Unger *ubi supra*, and Wilkinson, II. p. 403, do not mention it. The banana is now cultivated in Egypt.

† Forster, *Plant. Esc.* p. 28.

‡ Clusius, *Exot.* p. 229; Brown, Bot. Congo, p. 51.

§ Roxburgh, *Corom.* tab. 275; *Fl. Ind.*

‖ Rumphius, *Amb.* V. p. 139.

¶ Loureiro, *Fl. Coch.*, p. 791.

** Blanco, Flora, 1st edit. p. 247.

†† Finlayson, *Journey to Siam*, 1826, p. 86. According to Ritter, *Erdk.* IV. p. 878.

at the southern extremity of Siam. Thwaites* saw the variety *M. sapientum* in the rocky forests of the centre of Ceylon, and does not hesitate to pronounce it the original stock of cultivated bananas. Sir Joseph Hooker† and Thompson found it wild at Khasia.

The facts are quite different in America. The wild banana has been seen nowhere except in Barbados,‡ but here it is a tree of which the fruit does not ripen, and which is consequently in all probability the result of cultivated varieties of which the seed is not abundant. Sloane's *wild plantain*§ appears to be a plant very different to the *Musa*. The varieties which are supposed to be possibly indigenous in America are only two, and as a rule far fewer varieties are grown than in Asia. The culture of the banana may be said to be recent in the greater part of America, for it dates from but little more than three centuries. Piso‖ says positively that it was imported into Brazil, and has no Brazilian name. He does not say whence it came. We have seen that, according to Oviedo, the species was brought to San Domingo from the Canaries. This fact and the silence of Hernandez, generally so accurate about the useful plants, wild or cultivated in Mexico, convince me that at the time of the discovery of America the banana did not exist in the whole of the eastern part of the continent.

Did it exist then in the western part on the shores of the Pacific? This seems very unlikely when we reflect that communication was easy between the two coasts towards the Isthmus of Panama, and that, before the arrival of the Europeans, the natives had been active in diffusing throughout America, useful plants like the manioc, maize, and potato. The banana which they have prized so highly for three centuries, which is so easily multiplied by suckers, and whose appearance must strike the least observant,

* Thwaites, *Enum. Pl. Cey.* p. 321.
† Aitchison, *Catal. of Punjab*, p. 147.
‡ Hughes, *Barb.* p. 182, Maycock, Fl. *Barb.* p. 396.
§ Sloane, Jamaica, II. p. 148.
‖ Piso, edit. 1648, Hist. Nat. p. 75.

would not have been forgotten in a few villages in the depths of the forest or upon the littoral.

I admit that the opinion of Garcilasso, descendant of the Incas, an author who lived from 1530 to 1568, has a certain importance when he says the natives knew the banana before the conquest. However, the expressions of another writer extremely worthy of attention, Joseph Acosta, who had been in Peru, and whom Humboldt quotes in support of Garcilasso, incline me to adopt the contrary opinion.* He says "the reason the Spaniards call it *plane* (for the natives had no such name) was that, as in the case of their trees, they found some resemblance between them."† He goes on to show how different was the *plane (Platanus)* of the ancients. He describes the banana very well, and adds that the tree is very common in the Indies (*i.e.* America), "although they (the Indians) say its origin is Ethiopia, . . . There is a small white species of plantain (banana), very delicate, which is called the Espagnolle‡ *dominico*. There are others coarser and larger, and of a red colour. There are none in Peru, but they are imported thither from the Indies,§ as into Mexico from Cuernavaca and the other valleys. On the continent and in some of the islands there are great plantations of them which form dense thickets." Surely it is not thus that the author would express himself were he writing of a fruit tree of American origin. He would quote American names and customs; above all, he would not say that the natives regarded it as a plant of foreign origin. Its diffusion in the warm regions of Mexico

* Humboldt quotes the Spanish edition of 1608. The first edition is of 1591. I have only been able to consult the French translation (1598), which is apparently accurate.

† Acosta, trans. lib. IV. cap. 21.

‡ That is probably Hispaniola or San Domingo; for if he had meant the Spanish language it would have been translated by *castillan*, and without the capital letter.

§ This is probably a misprint for *Andes*, for the word Indies has no sense. The work says (p. 166) that pineapples do not grow in Peru, but that they are brought thither from the Andes, and (p. 173) that the cacoa comes from the Andes. It seems to have meant hot regions. The word Andes has since been applied to the chain of mountains by a strange and unfortunate transfer.

may well have taken place between the epoch of the conquest and the time when Acosta wrote, since Hernandez, whose conscientious researches go back to the earliest times of the Spanish dominion in Mexico (though published later in Rome) says not a word of the banana.* Prescott, the historian, saw ancient books and manuscripts which assert that the inhabitants of Tumbez brought bananas to Pizarro when he disembarked on the Peruvian coast, and he believes that its leaves were found in the *huacas*, but he does not give his proofs.†

As regards the argument of the modern native plantations in regions of America, remote from European settlements, I find it hard to believe that the tribes have remained absolutely isolated and have not received so useful a tree from colonized districts.

Briefly, then, it appears to me most probable that the species was early introduced by the Spanish and Portuguese into San Domingo and Brazil, and I confess that this implies that Garcilasso was in error with regard to Peruvian traditions. If, however, later research should prove that the banana existed in some parts of America, before the advent of the Europeans, I should be inclined to attribute it to a chance introduction, not very ancient, the effect of some unknown communication with the islands of the Pacific or with the coast of Guinea, rather than to believe in the primitive and simultaneous existence of the species in both hemispheres. The whole of geographical botany renders the latter hypothesis improbable, I might almost say impossible, to admit, especially in a genus which is not divided between the two worlds.

In conclusion, I would call attention to the remarkable way in which the distribution of varieties favors the opinion of a single species—an opinion adopted, purely from the botanical point of view, by Roxburgh, Desvaux, and R. Brown. If there were two or three species, one would probably be represented by the varieties

* I have read through the entire work to make sure of this fact.

† Prescott, *Conquest of Peru*. The author has consulted valuable works; among others, a manuscript of Montesinos of 1527; but he does not quote his authorities for each fact, and contents himself with vague and general indications which are very insufficient.

suspected of being of American origin, the other would belong, for instance, to the Malay Archipelago or to China, and the third to India. On the contrary, all the varieties are geographically intermixed, and the two, which are most widely diffused in America, differ sensibly the one from the other, and each is confounded with or approaches very nearly to Asiatic varieties." De Candolle, *Origin of Cultivated Plants*, p. 304.

It may throw some light on this controversy to state that we have three species of *Musa* in Australia, one of which is very doubtfully separated from *Musa paradisiaca*, but whether they are distinct or not there can be no question that the manner in which the wild banana grows in the jungles of north-east Australia, the Malay Archipelago and the Philippines, is precisely the same. As one ascends the lower slopes of any of the mountains in the Malay Peninsula the jungle becomes almost exclusively an undergrowth of wild bananas with tall forest trees overhead. I could never see any difference between this species and the mode of its occurrence, and *M. banksii* of Queensland. There are two other species in the colony, namely, *M. hillii*, and *M. fitzalani*.

It would scarcely be believed to what an extend *Musa* occupies the jungle in many parts of the Malay Archipelago and the Philippines, or in the latter islands its supreme importance as an article of export. There is a village in the Island of Panay in the province of Iloilo named Abaca, which, as already stated, is the native name for the banana which produces the Manila hemp. This village has been so named from the excellent quality of its hemp, which is said to be prepared by allowing the fibre to lie in sand for a time. The species has been called *Musa abaca*, and *Musa textilis* by botanists, the name *Abaca* belonging to the Tagalo and Visayan languages, while the Spaniards call it Arbol de Cañamo or hemp tree. In the Calamianes group and in the Cuyos the natives meet on Sunday mornings under a clump of cocoa-nut trees, where fruits, vegetables, fish and very little poultry are offered for sale. Amongst the articles are large hanks of hemp fibre almost as fine and quite as glossy as silk. This is sold as thread,

and the natives scarcely use any other for sewing purposes. It is very tough. The finer portions of the fibre are used for weaving. A very serviceable and rather fine and glossy material is made from it, of rich golden colour and something like silk.

Abaca may be said to be, next to tobacco, the most important product of the Philippines. It is far more important than cotton. The plant grows to about fourteen feet high, producing a fruit which is quite uneatable. It grows with much rapidity. Many varieties are known, according to the kind of fibre which they produce, and each has a special name. At the end of three years, when the top blackens and bends, the outward bark is stripped off. It is cut in strips, soaked and beaten till the fibres are thoroughly separated, and then it is placed in the sun, taking care that it does not get mouldy. When dried it is washed again, and then dried again and gathered into bundles, as soon as all the foliaceous portions have been detached. It is propagated by suckers, which spring up at the roots of the old plant, and planted moderately closely, so that 5,000 square yards will grow 1,000 plants. When the plant is mature the bark is stripped every month, until the plant is five or six years old, when it dies.

It is not known when this culture and manufacture came to be introduced in the Philippines. Pigafetta curiously makes no mention of it, though he does mention the banana fruit and cotton. Dampier resided in Mindanao for six months in 1786, but he confounds the edible banana with that from which the hemp is obtained. He says: "As the fruit of this tree is of great use for food, so is the body no less serviceable to make cloths, but this I never knew till I came to this island. . . . When the fruit is ripe they cut it down close by the ground, if they intend to make cloth with it. One blow with a macheat or long knife will strike it asunder: then they cut off the top, leaving the trunk eight or ten feet long, stripping off the outer rind, which is thickest towards the lower end. Having stripped two or three of these rinds, the trunk becomes in a manner all of one bigness, and of whitish colour. Then they split the trunk in the middle, which

being done they split the two halves again as near the middle as as they can. This they leave in the sun two or three days, in which time part of the juicy substance of the tree dries away, and then the end will appear full of small threads. The women, whose employment it is to make the cloth, take hold of these threads one by one, which rend away quite easily from one end of the trunk to the other, in bigness like whited-brown threads, for the threads are naturally of a determinate bigness. As I observed their cloth to be all of one substance and equal fineness, but it is stubborn when new—wears out soon, and when wet feels a little slimy. They make their pieces seven or eight yards long, and their warp and woof all one thickness of substance." (Dampier's Voyages, Vol. I. Ch. XI.)

Abaca is cultivated in many provinces, but the fibre most esteemed comes from Albay in the south of Luzon, and especially from the towns of Donsol, Sorsogon, Tabaco, Camalig and Quipia. Silk is mingled with the finer kinds of fibre to produce cloths which are called Sinamay and Guinaras. The hemp banana grows in much abundance in the island of Leyte in the neighborhood of the towns of Maasin, Jilongas, Solmo, Carigara, Balobo, Tananan, Calvallo, Catarman, Catubic, Palapag, Besonhem, Guian, Basey, Paranas. Also Cagayan-Chico and Caminguin in the island of Misamis.

The export of this material after remaining many years of no value or importance to the Spanish colonies, has at last taken its proper place, and from day to day increases prodigiously in value. This is due to the alterations of the law of export. The Americans are the principal buyers at present.

250. MUSA PARADISIACA, L.

251. MUSA ABACA or MUSA TEXTILIS, L.

DIOSCORACEÆ.

252. DIOSCOREA SATIVA, L. This species of yam is widely spread over East Indies and the Archipelago, extending to Australia. There are many species nearly all of which have rhizomes, that is

underground stems or branches of stems more or less tuberous, which become larger when the annual exposed part of the plant is near its decay. These rhizomes are important as articles of food. The Chinese call all yams Tai-shu or big potatoes. The Japanese name is Yama-no-imo or mountain-potato.

253. Dioscorea triphylla, L.

254. Dioscorea pentaphylla, L.

255. Dioscorea hirsuta, Blume.

COMMELYNACEÆ.

256. Commelyna nudiflora, L. Little blue spider-worts with nothing remarkable about them except their pretty flowers which are generally seen in marshy places. The rhizomes of many of the species contain so much starch and mucilage that they are considered nutritious articles of food when cooked.

257. Commelyna bengalensis, L.

258. Aneilema nudiflora, L. A widely spread species in the East extending to Australia.

259. Cyanotis axillaris, Rœm. et Schult. This smooth annual with long creeping branches, and flowers in short dense spikes in a leafy bract or sheath, is common throughout all the East.

260. Cyanotis cristata, Rœm. and Schult.

PANDANACEÆ.

261. Pandanus odoratissimus, L. Pandan, Sabotan, Tagalo; Daun-bagea, Malay. The well known screw pines or screw palms, of which there are no less than twenty-one species in the Indian Archipelago, and five in Australia, including the one mentioned above. Seven or eight are recorded in the Philippines, including the one mentioned here, which is widely spread over tropical Asia and the Malayan Archipelago. In Queensland the screw pines are called bread fruits. This may arise from the fact that the pith of *P. bagea* is made into a kind of bread with sugar in Amboyna, and when cooked is wholesome and palatable. The young leaves are also boiled and eaten as a vegetable, but I do not know whether this is true of more than one species.

CYPERACEÆ.

The following determinations of sedges, for which a most careful search was made, probably does not include all that may be found. With scarcely any exception they are common tropical forms widely diffused through the East and often in Africa and America :—

262. Kyllinga intermedia, R. Br.
263. Kyllinga monocephala, Rottboell.
264. Kyllinga triceps, Rottboell.
265. Cyperus pumilus, L.
266. Cyperus globosus, All.
267. Cyperus flavicomus, Mich.
268. Cyperus pygmæus, Rottb.
269. Cyperus rotundus, L.
270. Cyperus exaltatus, Retz.
271. Heleocharis variegata, Kunth.
272. Fimbristylis acuminata, Vahl.
273. Fimbristylis nutans, Vahl.
274. Scirpus fluitans, L.
275. Scirpus grossus, L.
276. Rhynchospora aurea, Vahl.
277. Cladium mariscus, R. Br.
278. Scleria scrobiculata, Nees (?).
279. Carex bengalensis, Roxb.

GRAMINACEÆ.

With regard to the grasses, I have the same remark to make as in the case of the sedges. Careful and extensive collections were made for me, but I do not suppose they include all to be found in

the island, though the list is larger than that of Señor Centeno. At the time of my second visit, every bit of grass was burnt off the island. I do not include all the cultivated species or varieties. For instance there are said to be nearly fifty species or varieties of Rice (*Oryza*).

280. Zea mays, L. An American plant which came to Europe through the Spaniards, but had been previously cultivated in China. Still all this is a matter of much controversy, for which see Bonafous, Histoire Naturelle Agric. and Economique du Maïs, 1 vol. fol. Paris et Turin, 1886; see, also, De Candolle, loc. cit. The leaves of the maize plant are capable of yielding a nutritive substance or bread-stuff for human food, a fibrous material capable of being spun and woven like flax, and ultimately a pulp from which a most beautiful paper can be produced. So strong and durable is maize paper, and so great its natural transparency and firmness, that it can be used as an excellent substitute for glass in windows. Lately *Stigmata maidis* have enjoyed much repute as a remedy in nephritic disorders.

281. Bambusa arundinacea, Retz. Besides several other species or varieties of bamboo.

282. Oryza sativa, L. Malay, Bras; Visayan, Bogas, besides many other terms.

283. Paspalum distichum, L.

284. Panicum sanguinale, L.

285. Panicum flavidum, Retz.

286. Panicum distachyum, L.

287. Panicum crus-galli, L.

288. Panicum repens, L.

289. Setaria glauca, Beauv.

290. Lappago racemosa, Willd

291. Heteropogon contortus, Rœm. and Schult.

292. Ischæmum ciliare, Retz.

293. Ischæmum muticum, L.

294. Andropogon sericeus, R. Br.

295. Andropogon schœnanthus, L.

296. Imperata arundinacea, Cyrillo. This is the common jungle grass or lalang of the Malay Peninsula.

297. Chrysopogon gryllus, Trinus.

298. Chrysopogon aciculatus, Trinus.

299. Sorghum halepense, Pers. Probably an escape from cultivation.

300. Anthistiria ciliata, L.

301. Aristida depressa, Retz.

302. Chloris truncata, R. Br.

303. Chloris barbata, Schwartz.

304. Cynodon dactylon, Pers.

305. Leptochloa chinensis, Nees.

306. Sporobolus indicus, R. Br.

307. Eragrostis tenella, Beauv.

308. Eragrostis plumosa, Link.

309. Eragrostis pilosa, Beauv.

FILICES.

310. Gleichenia flagellaris, Spreng.

311. Gleichenia dichotoma, Willd.

312. Hymenophyllum polyanthus, Swartz.

313. Hymenophyllum javanicum, Spreng.

314. Trichomanes parvulum, Poiret, or saxifragoides, Presl.

315. Davallia ciliata, Hooker.

316. Davallia vestita, Bl.

317. Adiantum lunulatum, Burm.

318. Adiantum caudatum, L.

319. Cheilanthes tenuifolia, Sw.

320. Onychium auratum, Kaulf. Very common in crevices of old walls and rocks about Manila.

321. Pteris longifolia, L.

322. Pteris cretica, L.

323. Pteris ensiformis, Burm.

324. Pteris quadriaurita, Retz.

325. Pteris aquilina, L.

326. Pteris incisa, Thunb. Some small young plants which I found growing in cavernous crevices near Point Calavita, I doubtfully refer to this species, but it much resembled specimens which I have found under similar conditions in Australia.

327. Blechnum orientale, L.

328. Asplenium esculentum, Presl.

329. Aspidium aculeatum, Sw.

330. Polypodium simplicifolium, Hook.

331. Polypodium quercifolium, L. (?)

332. Polypodium hookeri, Bracken.

333. Vittaria elongata, Sw.

334. Drymoglossum piloselloides, Presl.

335. Acrosticum aureum, L.

336. Acrosticum conforme, Sw.

337. Lygodium dichotomum, Sw.

Besides the above, collections were made of a few fungi, lichens, and mosses, but they have not been determined.

The flora enumerated above is a singular one, as it is almost entirely confined to the common weeds of the Indian Archipelago, and plants brought into the island for cultivation and becoming naturalized. It is interesting, however, to observe what a very large proportion of these are plants which contain some useful or highly ornamental properties. Truly it may be said of the oriental flora that there is scarcely anything in the vegetable kingdom which is entirely useless or unimportant. The flora of the Taal volcano may be described as almost a derived one, due of course, to the fact that it has been over and over again destroyed by the eruptions of the mountain, and it is only those plants with facilities for spreading themselves which have had time to establish themselves on the slopes of the volcano. Though the flora of the Philippine Islands is not in general different from the Malay Archipelago, yet it has features of its own, none of which are visible at Taal. The last eruption has probably destroyed most of the species collected by the Spanish botanist and myself, and subsequent observers will find an entirely new flora.

In addition to the list given above I find the following species amongst my collection with no locality mentioned on them. They may have come from the mainland about Tanauan :—*Justicia mollissima*, Wall.; *J. gendarussa*, L. ; *J. procumbens*, L.; *J. diffusa*, Willd. ; and *J. dichotoma*, Bl.—All Philippine but not at Manila ; *Asystasia coromandeliana*, DC., wild in Mariquina, Luzon ; *Acanthus ilicifolius* in estuaris ubique ; *Crossandra infundibuliformis*, DC., a pretty little acanthad with salmon-coloured blossoms, cultivated much in Hong-kong, not common as an escape, and can hardly be said to be naturalized ; *Rhinacanthus communis*, and some others.

FISHES.

During my short stay in the neighborhood of the lake of Bombon I had no opportunities for the collection of fishes. All I could do was to visit the fishermen's boats and see the kinds offered for sale. The number of species was not numerous, and those I could obtain a sight of, circumstances prevented me from subjecting to a careful examination or comparison. I believe amongst a number that I could not identify with the aid of the books at my disposal, the following common and widely-distributed Indian species were provisionally identified.

Lutianus johnii, Bloch.

Mandus marmoratus, Cuv. and Val.

Sillago sihama, Bloch. Lake Bombon.

Polynemus tetradactylus, Shaw.

Platycephalus insidiator, Forskal.

Otolithus argentius, Kuhl and van Hasselt.

Pristipoma commersoni, Lacep.

Pristipoma nigrum, Mertens.

Anabas scandens, Daldorf.

Ophiocephalus striatus, Bloch.

Mugil cephalotus, Cuv. and Val.

Mugil cunnesius, Cuv. and Val.

Elacate bivittata, Cuv. and Val.

Caranx leptolepis, Kuhl and van Hasselt.

Caranx nigripes, Cuv. and Val.

Stromateus niger, Bloch. This is the pomfret, a highly prized fish in the Straits of Malacca; in fact the Europeans do not care to consume many others.

Drepane punctata, Linn.

Platax vespertilio, Bloch.

Arius thalassinus, Rupp.

Calichrous bimaculatus, Bloch.

Plotosus angularis, Bloch.

Clarias dussumieri, Cuv. and Val. If I am right in this identification this is a common fish in the ditches and streams about Manila, and may be the species which is consumed in such numbers in the Laguna de Bay. It is called by the natives Candolia.

Notopterus kapirat, Lacep.

Muræsox cinereus, Forskal.

Histiophorus brevirostris, Playfair.

Echineis neucrates, Linn.

Antennarius nummifer, Cuv. On floating sea-weed outside the Bay of Taal.

Trygon walga, Mull.

Besides sharks, eels, pipe-fishes, sea-horses, file-fishes, coffer-fishes, globe-fishes, &c. On one day we passed through a shoal of what appeared to be herrings in leaving the anchorage. Flying fish were also numerous. A good work on the ichthyology of the Philippines is a great desideratum in natural history. At present scarcely anything is known. No doubt the fish fauna belongs generally to the Indian region, but seeing how many peculiar forms have been revealed by the French naturalists in Cochin China, we might well expect similar and important results from a study of those of this interesting Archipelago. The fish fauna is particularly rich, like that of all islands surrounded by a deep sea and a coral formation.

MOLLUSCA.

This list is meant to include only the freshwater mollusca found within the lake or the river Pansipit.

1. CYRENA SUB-ORBICULARIS, Van d. Busch; Philippi, Abbildungen und Beschr. neuer Conch. Bd. III. p. 77, pl. II., fig. 1., 1849. A somewhat solid sub-orbicular shell, with a distinct posterior undulation extending from the umbones to the margin. It is covered with an olive-green, shining, neat periostraca, which projects in concentric asperities along the lines of growth, which are crowded. It is not much eroded, and has altogether a cleaner appearance than most members of the genus. Very common in all the ditches and stagnant waters about Manila, Laguna de Bay, &c.

2. CORBICULA CROSSEANA, Petit. A small tumid shell with regular rounded sulcations, covered with a brownish olive periostraca, underneath which the shell is purple, especially at the umbones, where it is eroded. The transverse ribs between the sulci are rounded. The enormous quantities of this mollusk are indescribable. Along the river Pasig there are duck farms extending for many miles on both banks, and maintaining hundreds of thousands of ducks. They are almost entirely fed on the river mollusca, and principally on this *Corbicula*. At Los Baños, in the Laguna de Bay, where the boiling springs from Maquilin empty themselves into the lake, there are large heaps of these shells destroyed by the hot water, together with a *Paludina* to be mentioned presently. The lake mollusks are also sold in the markets as food for fowls. They are brought down in bags by the passenger steamers which ply upon the lake. Nevertheless, there seems no diminution of the supply; in fact, this continued clearing off of the surplusage would seem to have a happy effect in giving room for the fullest development of the young mollusks. I have been informed that the supply, if anything, is increasing.

3. Neritina dubia, Chemnitz, V. 324, figs. 2019 and 2020, and (according to Wood's Index Testaceologicus) *N. dubiosa*, 244 ; *N. Philippinarum*, Sowerby ; *N. reticulata*, Quoy ; *N. zebroides*, Lesson, teste Récluz. This *Neritina* varies between shining black with minute yellow spots or yellow zigzag diagonal markings, and a distinctly banded form of a great variety of patterns and colours, such as yellow and black, yellow and red, and in the centre of the red lines a black band with minute chevrons. There are also black and white shells of a broad zebra pattern. The aperture is obliquely produced, the columella is broadly enamelled with white, and furnished with minute teeth. The operculum of one large spiral like an argonaut shell with a central ridge, rugose lines of growth and no granulations. On the inner side it is polished, has a broad ridge which terminates spirally in two prominently projecting claws. Found abundantly in one place only on the sands at the exit of the river Pansipit.

4. Paludina tricarinata, Anton. A diaphanous olive-brown shell, elongately turbinate, slightly umbilicate with a pale blue columella. The whorls have three distinct sharp keels, with several smaller intermediate ones and a channel suture. Large quantities of this shell are found in all the rivers and streams of the Philippines. It is a type which belongs to the Asiatic tropical regions, and though several species have been distinguished on minor features, yet they pass into one another in a way that renders identification almost impossible. Generally speaking, all the specimens are distinctly tricarinate, but the intermediate keels vary in their prominence and importance, so that it becomes a matter of opinion whether there are three, four, five, or more. There are considerable numbers—as already stated—at Los Baños killed by the hot water, and there are others of the same type showing certain variations in the River Pansipit, and along the small streams emptying into the Laguna de Bombon.

5. Melania aspera, Gmelin. A peculiar, somewhat short species, with distinct tubercles on the upper margin of the whorl,

besides having numerous granular sulci all over the shell. There is an unmistakable figure of this little species in Wood's Index Testaceologicus, Pl. 34, Fig. 131, Hanley's Edition, London, 1856. The species is common throughout the rivers and streams of the Philippines.

6. Melania fuscata, Born. A narrow subulate species of ten whorls, obsoletely tubercular at the upper portions of the spire. Whorls 10, with a thick blackish-olive periostraca, with rusty erosions; mouth white; outer lip very sinuous.

There are many other fluviatile species to be found in connection with the river and lake of the volcano, but these are all I succeeded in recognizing. The estuarine shells, unfortunately, became mingled with collections from other portions of the islands, but as well as I can remember, I only succeeded in procuring few species, one of which is certainly *Auricula auris midæ*.

LAND MOLLUSCA.

One or two shells of the genera *Helix* and *Bulimus* were found on the volcano of Taal, the *Helix* being possibly a variety of the large *H. maxima*. The extraordinary richness of these islands in *Helicidæ* is well know. They are inferior in number only to those of Lusitania and the Antilles, and vastly superior in size and beauty of colouring. The *Cyclostomidæ* are probably equal in number to those of India. Nearly all the species are confined to particular islands, but the form and colouring vary but slightly, so that possibly they are no more than local varieties (Dr. Woodward).

The *Bulimi* of the Philippine Islands, which are very numerous and of large size, chiefly belong to one type, represented by *B. pythogasta*, Fer., *B. bicoloratus*, Lea, *B. lignarius*, Pfr., *B. fulgetrum*, Brod., *B. nimbosus*, Brod., and others. The shells

of this type are not so much distinguished by colour as by the presence of a double membranaceous periostraca, to which the different species are indebted for their characteristic patterns. *B. cumingii*, Pfr., and *B. leaii*, Pfr., and a few others belong to another type. In this the shell is inflated, mostly shining white with only a very thin single periostraca. About 80 species have been collected, each, with the exception of about half a dozen, confined to its particular island. Some live on the branches of trees, but a few, such as *B. elongatulus*, Pfr., and *B. panayensis*, Pfr., burrow underground. These are transparent and horny (Reeve Elem. Conch. 1860). I found a very great resemblance in type between the Philippine land shells and those of Borneo.

EXPLANATION OF PLATES.

PLATE XVIII.—Map of S. Luzon with Lake Bombon.

XIX.—Map of Volcano Island, Taal.